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The Prussian Idea

"When a new man comes to work in my plant," said Plimpton bluntly, "the first thing I beat into his head is the fact that I'm boss and that whatever I say, goes."

He was a big, broad hulk of a man, with a heavy chin, and I had no doubt that he was fully capable of making his authority plain to his subordinates. In fact, he was just the type that would enjoy to the utmost the sense of boss-ship.

"But what do you do when you run against a man who has a mind of his own?" I inquired.

"Break him or bounce him," was Plimpton's quick retort. "Either he does as I say or he gets his walking papers. I won't have any man around who talks back."

"But what about initiative?" I pursued.

Plimpton frowned perplexedly.

"I don't quite get you," he said.

"Suppose something goes wrong—something that needs quick attention. Do you expect to be consulted?"

"Of course I do," he boomed. "I'm the man who's got to take the responsibility for the way things are run, and that being the case, I'm going to say how they're to be done."

"It doesn't sound good to me," I told him frankly.

"It doesn't, eh?" he grunted. "Well, what's the matter with it?"

"It doesn't treat the men as though they had any brains of their own."

"Lots of them haven't," he declared. "Some fellows I've had were most mighty thick."

"But you can't develop them into thinking men by your method," I told him. "You discourage every man under you. He may have a good idea as to how to do his work, but you make him run to you for your O.K. on everything he does. The result is, you make a bunch of weaklings where you ought to have the strongest kind of support. Those men are just like so many pieces of machinery—you've got to start them and stop them."

"You bet I do!" was his confident boast. "Believe me, they do what I say, when I say it!"

"Yes," I added. "You've got them buffaloed—afraid to call their souls their own. That's a fine spirit to have in any organization!"

"It's always worked well with me," he insisted.

"You're living in a fool's paradise," I said. "Some of these days you aren't going to be within earshot, or even telephoning distance, and an emergency is going to come like a streak of lightning. There won't be any chance for your men to get your advice—there wouldn't be time to use it if they did get it. Then, with nobody to fall back on, and not one full-fledged opinion in the brains of the whole crowd, they're going to guess wrong, and—zowie! You'll be darned lucky to be absent just about that time!"

Plimpton didn't answer immediately. I waited a moment—still no reply. So I picked up my hat and tiptoed out. At the door I glanced back.

Plimpton was hunched in his chair, one hand tugging at his bristly mustache, and a heavy furrow was deepening between his eyebrows.

Plimpton was thinking, and thinking hard!

By RUFUS T. STROHM

"Gasteam" Plant at Ford City, Ontario

A Combination Alternating- and Direct-Current Plant Employing "Gasteam" Engines—Boiler-Feed Water to Recover Waste Heat from Gas-Engine Cylinder Jackets—Gas-Producer Plant of Unusual Interest —Operating Methods Differ from Ordinary

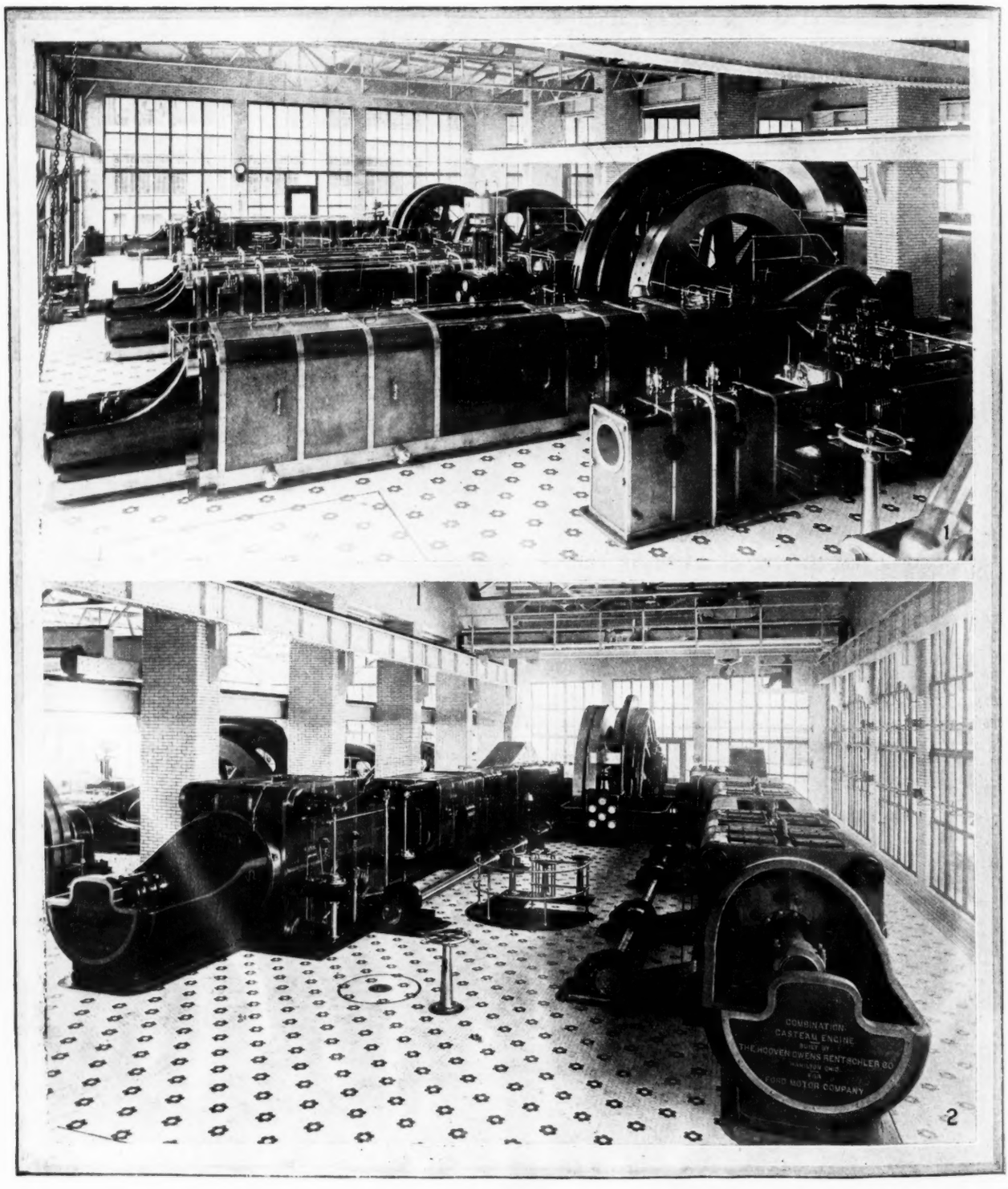


FIG. 1. GENERAL VIEW OLDER SECTION OF ENGINE ROOM. FIG. 2. 3000-KW. DIRECT-CURRENT "GASTEAM" UNIT

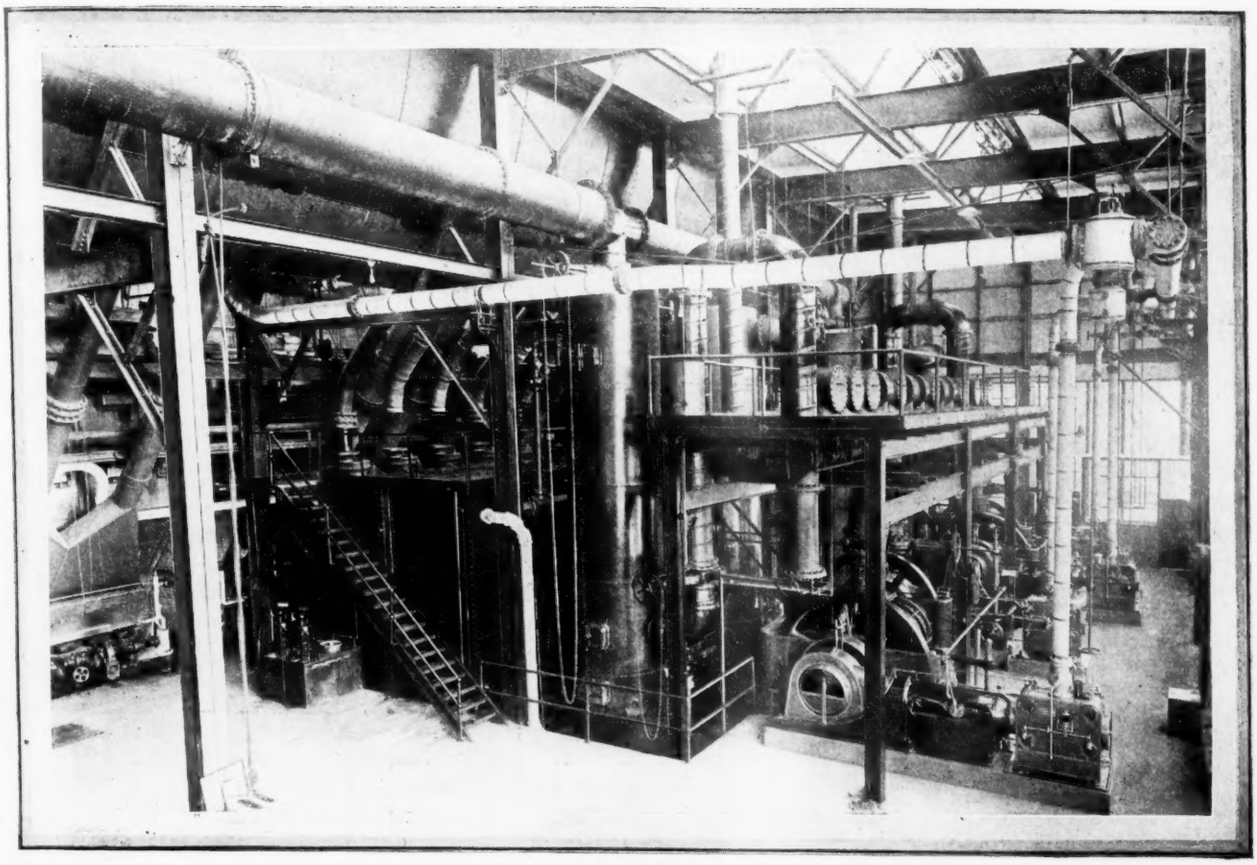


FIG. 3. GENERAL VIEW OF THE GAS PRODUCER AND BOILER ROOM

THE Ford Motor Company of Canada, Ltd., located on the Canadian side of the Detroit River at Ford City, Ontario, about ten miles from the Highland Park plant in Detroit, has been enlarging its shops to care for the increasing demand for its product. The present capacity is about 275 cars per day. The need for more power called for an addition to the power plant, and this will follow closely in design the general arrangement of the Highland Park plant in Detroit, described in previous issues of *Power*[1]. There will be "gasteam" engines driving direct-current generators. The boiler-feed water will recover the heat from the cylinder jackets of the gas engines, and the condensers of the steam sides of the units will be used eventually as heaters for the hot-water heating system serving the shops.

At the present writing a 3000-kw. "gasteam" engine is being installed in the new section of the plant, Fig. 2. The steam side is already running and the gas engine side is nearing completion. Later, a second unit of the same size and type will be added. From the description of the Ford plant at Detroit it will be remembered that the units consist of a gas engine with tandem cylinders on one side of a direct-current generator and a tandem-compound Corliss engine on the other side. The generator in the present case is a 250-volt, direct-current machine rated at 3000 kilowatts. The speed is 80 r.p.m. The gas-engine cylinders are 42 x 72 in. and the steam cylinders 30 and 60 x 72 in. As it is intended to use steam at approximately 600 deg. temperature, the high-pressure cylinder is equipped with poppet valves while the low-pressure cylinder has valves of the standard Corliss type. The valve gear on either engine, the method of governing, cylinder and piston cooling in the gas engine and the ignition system, are practically direct copies of the installation at Highland Park, so that for details reference may be made to the previous articles.

The condenser serving the steam engine is of the surface type containing 4900 sq.ft. of surface, or 1.63 sq.ft. per kilowatt of generator rating. In common with a condenser in the older section of the plant, it is served by a motor-driven circulating pump and an 18 x 12-in. electric-driven Edwards pump to remove the air and condensate. The circulating water comes from the river and for the present is returned to the source of supply. As in the case of the other plant, it is proposed, however, to tie in the hot-water heating system with the power load. The circulating water will pass through the condensers and also through a large tubular heater to which live steam will be automatically admitted when the exhaust steam from the power load is insufficient to maintain the water at the desired temperature. The expectation is to operate on a vacuum approximating 20 inches.

Exhaust from the gas engine passes through a reheating receiver located, as at the Highland Park plant, between the high-pressure and low-pressure cylinders of the steam engine. After drying and superheating the steam, the exhaust gases pass on through an underground pipe to escape through a standpipe at the bank of the river.

In the older section of the plant, Fig. 1, three-phase

[1]Nov. 21, 1916; Jan. 16, Feb. 20, Mar. 6, 1917.

60-cycle current is generated at 220 volts. The rated capacity is 2525 kw. made up in three units. There are two tandem-cylinder 24 x 36-in. gas engines, each driving a 500-kw. generator and a 200-hp. air compressor with cylinder dimensions of 13 x 24 in. A "gasteam" engine with 24 x 36-in. tandem gas cylinders and 18 x 34 x 36-in. tandem steam cylinders, drives a 1150-kw. generator. The third electrical unit is a 375-kw. reaction turbo-generator, Fig. 8, with complete condensing equipment. In addition to the generating machinery there is a 13 x 26 x 24-in. two-stage air compressor driven by a cross-compound steam engine, Fig. 7, the Badenhausen boilers, four rated at 380 hp. each and two 500-hp. units. They are served by five- and seven-retort underfeed stokers respectively. The operating pressure is 180 lb. gage and the superheat 150 deg. Fig. 5 shows a vertical section through the boiler room and the coal annex. Fig. 6 is a transverse section through the boiler and producer room.

As some of the steam is used in the shops and not returned to the boilers, there is need for considerable makeup. At present the condensate and high-pressure drips are delivered to a hotwell and makeup river water is admitted under float control. When present plans are

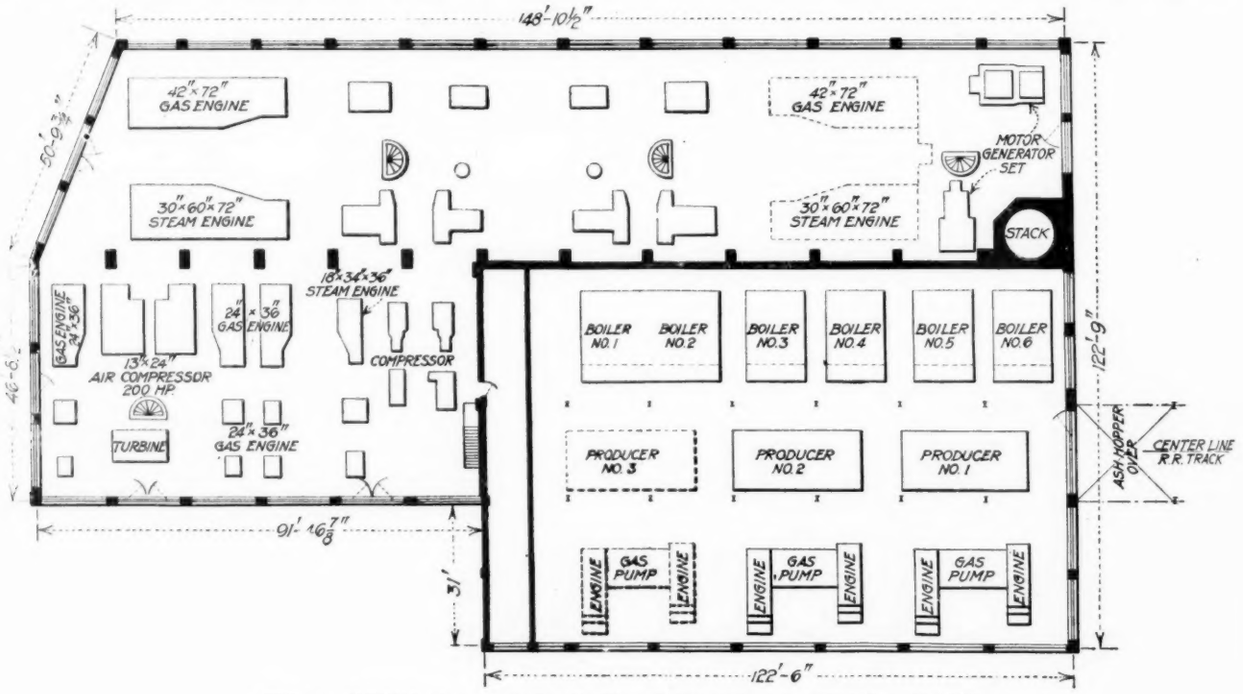


FIG. 4. GENERAL LAYOUT OF THE FORD CITY "GASTEAM" PLANT

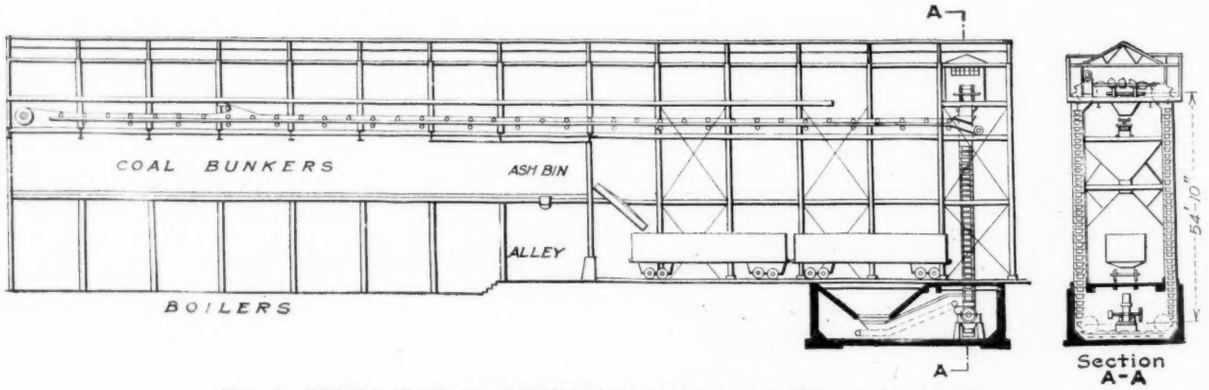


FIG. 5. VERTICAL SECTION THROUGH BOILER ROOM AND COAL ANNEX

maximum speed being 165 r.p.m. This engine and the steam engine of the "gasteam" unit are served by a surface condenser provided with 4200 sq.ft. of surface. The auxiliaries are a circulating pump and a 12 x 10-in. air pump. The former also serves the condenser of the new 3000-kw. direct-current unit. Its capacity is 3500 gal. per min., and it is driven by a 150-hp. direct-current motor. The general layout of the plant is shown in Fig. 4. The instrument panels and benchboard are shown in Fig. 9.

To generate steam for the plant there are six standard

put into effect, the boiler supply will be passed through the cylinder jackets of the gas engines to a large tank supplying the feed pumps, in which the temperature will be raised to about 180 deg. F. There are two feed pumps, eight-stage centrifugals, one driven by a 60-hp. direct-current motor and the other by a turbine. The exhaust steam from the turbine, when run through an open heater, is sufficient to further heat the feed water from 180 to approximately 210 deg. An individual regulator controls the feed to each boiler.

Coal is delivered from railroad cars to a track hopper

located in a coal tower exterior to the plant. An 18-in. apron conveyor carries it to the crusher, from which it reaches the overhead bunker through a continuous bucket conveyor delivering onto a belt conveyor provided with an automatic tripper. The capacity of the equipment is 40 tons per hour.

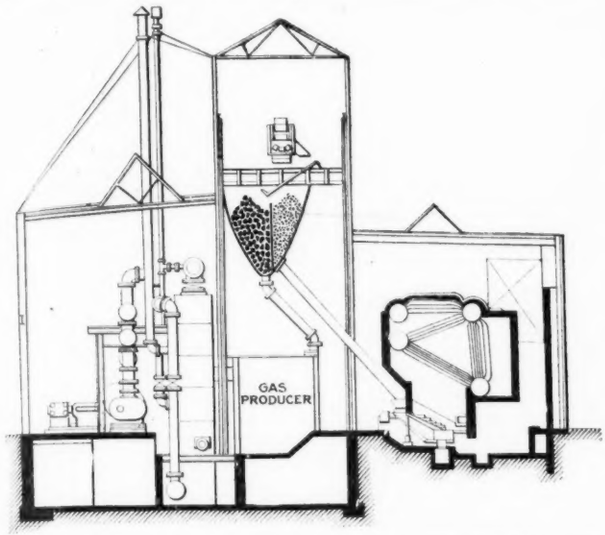
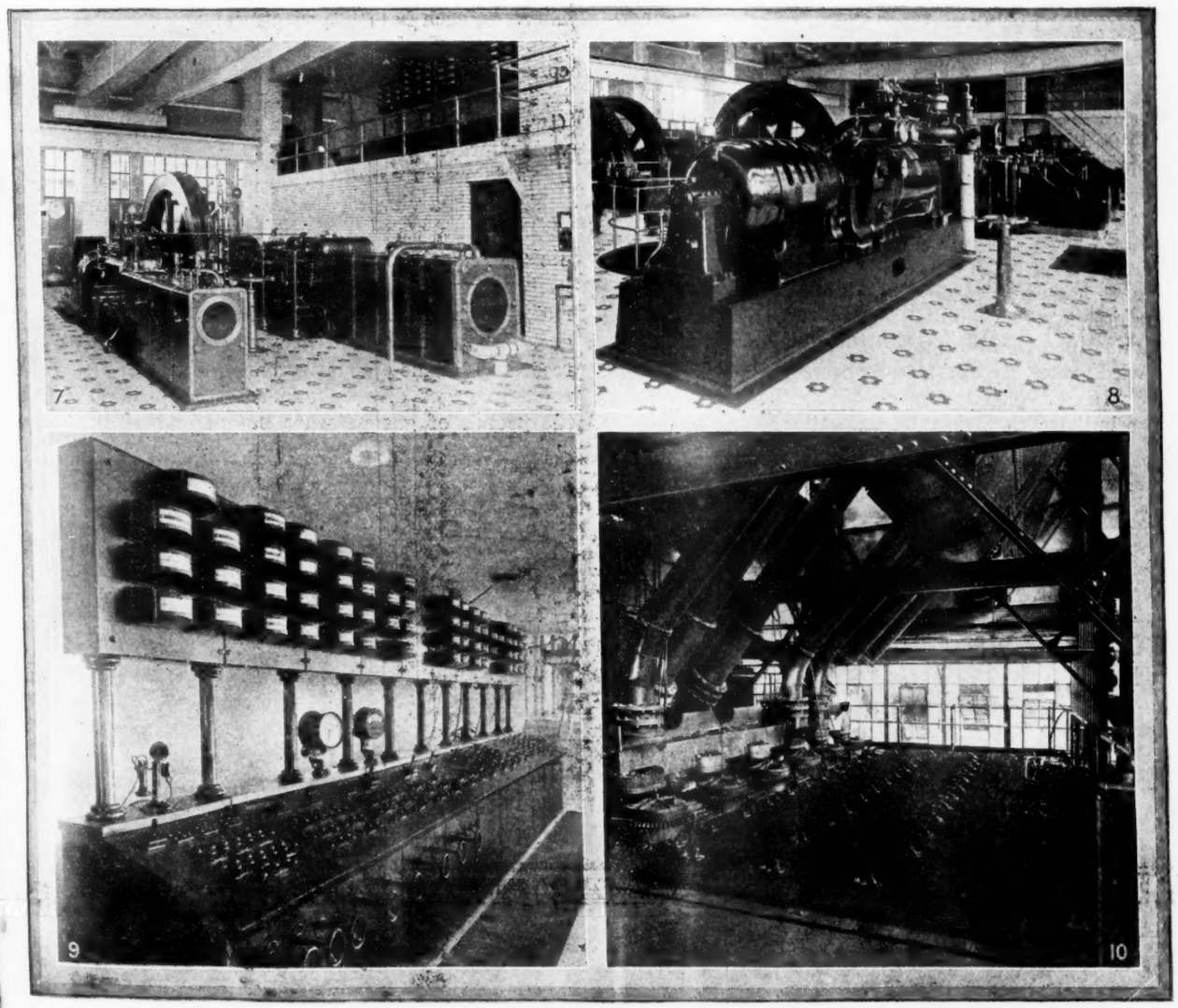


FIG. 6. TRANSVERSE SECTION THROUGH BOILER AND PRODUCER ROOM

As both the gas producers and the boilers draw fuel from the same bunker, provision is made to separate the lump and fine coal, the latter being for the boilers and the lump up to 3 in. for the producers. The coal from the belt conveyor drops onto a sloping grating extending along one side and for the length of the bunker. The lump coal rolls off the grating to the opposite side of the bunker, and the fine coal passes through. A division wall at the center separates the lower part of the bunker into two compartments, chutes from one compartment leading to the boilers and chutes from the compartment on the opposite side leading to the producers. A steam-jet system is employed to remove the ashes.

A feature of particular interest in the plant is the gas-producer installation. The equipment is the last word in producer design. For the first time, tar separated from the gas is returned to the producer and gasified with remarkable success. This method of tar disposal has proved to be better and more profitable



FIGS. 7 TO 10. GENERAL VIEWS IN THE POWER PLANT

Fig. 7—Cross-compound steam-air compressor and switchboard gallery. Fig. 8—Small turbo-generator in foreground. Fig. 9—Instrument panels and benchboard. Fig. 10—Producer tops showing coal delivery

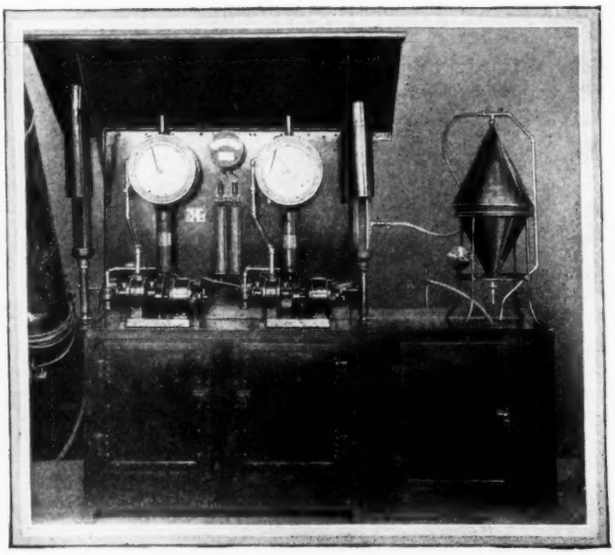


FIG. 11. THE GAS-TESTING CABINET

than the old system of burning it under the boilers. The heat value of the gas is increased considerably when the tar is gasified.

At present there are two Smith gas producers, Fig. 10, each rated to gasify 50 tons of coal per day of 24 hours. A third unit is being installed. Each producer is built up in six sections. The rate of driving in each section can be separately controlled, preventing channeling and unequal blast distribution in the fuel bed, the latter being contained in a single large chamber and supported by inclined grates rising at an angle of 35 deg. from the back wall of the producer. Between the bottom of the inclined grates and the wall are heavy clinker bars, the function of which is to crush and pass through to the ashpit all clinker that settles through the fuel bed to the grates. Both clinker bars and inclinded grates are operated by compressed-air cylinders.

Coal is charged to the producers through a vertical port built in the front lining wall of each section by means of a mechanical stoker designed to permit the charging of coal without admitting air. Each stoker may be started or stopped by engaging or disengaging its driving pawl. The ashpits are, of course, directly under the grates of each section and drop away from the front of the producer at an angle approximating that of the grates. The doors of the ashpits open into a tunnel under the floor line at the back of the producer. The ashes are removed from the tunnel by a steam-jet conveyor.

The cleaning apparatus consists of 14 spun-glass wool tar extractors which are simple and efficient. The upper housing of the extractor contains a diaphragm of spun-glass wool (1½ lb. to each extractor) through which tar-laden gas is driven at high velocity, causing an agglomeration of tar particles until they are of sufficient size to drop out of the gas by gravity. The life of the spun-glass wool is from two to three months, depending on the quality of the wool used and the care taken in packing it in the diaphragm. The tar flows from the tar extractors to a tank 36 in. in diameter located in the basement, and is pumped from there to a series of nozzles which spray the tar back into the producer.

The gas is drawn from the producers by two exhausters, each having a displacement of 45.2 cu.ft. per revolution. Each exhauster is driven by a twin direct-connected 11 x 24-in. high-speed Corliss engine. Cooling of the gas is effected by four large cooling towers (two to each producer), each being equipped with three water sprays. The water is supplied through a 6-in. line at a pressure of 20 pounds.

Fig. 11 is a view of the gas-testing cabinet employed at the plant. The two instruments with large white dials are calorimeters, their function being to record the heat units per cubic foot in the gas. Below are the motor-driven exhausters supplying the instruments with gas. The round gage between the calorimeters is a recording thermo-electric pyrometer. The two elongated pressure gages directly under the pyrometer register the pounds of gas pressure before and after the tar

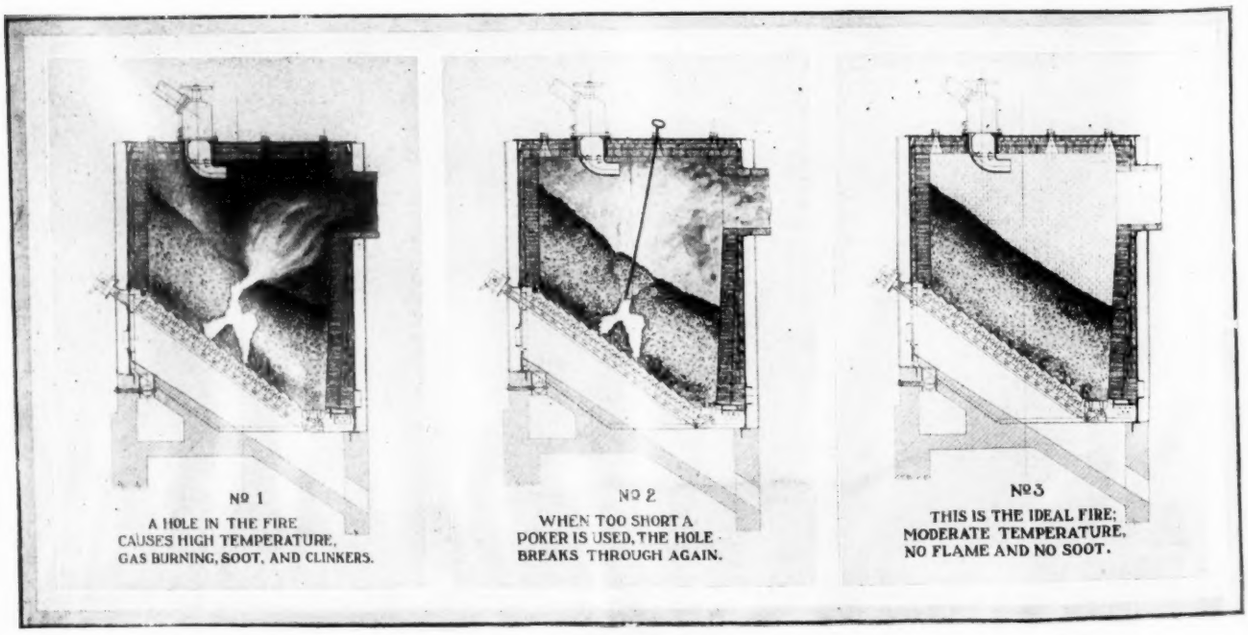

Nº 1
A HOLE IN THE FIRE CAUSES HIGH TEMPERATURE, GAS BURNING, SOOT, AND CLINKERS.
Nº 2
WHEN TOO SHORT A POKER IS USED, THE HOLE BREAKS THROUGH AGAIN.
Nº 3
THIS IS THE IDEAL FIRE; MODERATE TEMPERATURE, NO FLAME AND NO SOOT.

FIG. 12. THREE VIEWS OF GAS-PRODUCER FUEL BED USED FOR OPERATOR'S INSTRUCTION

extractors. At the right of the photograph is shown the double cone-shaped receptacle used to indicate the amount of tar in the gas. Its volume is one cubic foot.

Through the bottom cock water is admitted to the vessel. When it is full, the device supported on brackets at the left is fitted with a filter paper and is connected between the gas line and the top of the testing receptacle. The water is then allowed to run out, the gas following as the water recedes. When the water has been entirely replaced, the vessel contains 1 cu.ft. of gas, and this quantity has passed through the filter paper, leaving an indication of the amount of tar contained in the gas.

GAS PRODUCER LOG

DATE Jan 28th 1918 PRO. NO. 1

TIME	PRESSURES		VACUUMS			UNDER GRATES						TEMPERATURES						WATER		
	CALORIMETER	BEFORE TAR EXTRACTORS	AFTER TAR EXTRACTORS	HOT PIPE	AFTER PRIMARY CONDENSER	BEFORE EXHAUSTER	1	2	3	4	5	6	SATURATION	HYGROMETER	AFTER PRIMARY CONDENSER	BEFORE SECOND CONDENSER	AFTER SECOND CONDENSER	TAR TANK	PRESSURE	TEMPERATURE	
7am	185	3"	1"	1"	2½"	4"	½	½	½	½	½	½	145	110	100	130	40	130	20	32	120
8 "																					
9 "																					

Started exhauster at
On line at
Stopped exhauster at
Off line at
Depth of fuel bed at was
" " tar in tank at "
Burned tar hours
Men reporting late
" absent

REMARKS.

Operator

FIG. 13. LOG USED IN THE PRODUCER ROOM OF THE PLANT

Of course the method of working the fuel bed has a great deal to do with the efficiency of the plant. In the producers under discussion the fuel bed reposes at an angle of 35 deg., and when the grates are shaken the fuel moves obliquely along the inclined bed. Three firemen on top of each producer watch closely for holes, channels or ridges in the fuel bed, particularly along the wall, where trouble of this character develops most frequently. As the combustion chamber measures in plan 10 x 24 ft., each man cares for 80 sq.ft. of projected grate area. The depth of fuel bed averages about 5 ft. on the high side of the grate and 7 ft. along the back wall. To keep the bed compact, ¾-in. steel bars

In the operation of the producer plant there are several features worthy of special mention. On leaving the fire the gas passes through a brick-lined hot pipe to a primary cooling tower, where its temperature is reduced from about 1100 deg. F. to 120 deg. F., or to a temperature that will insure efficient operation of the tar extractors. It then passes through a low-pressure header into the exhauster, which delivers the gas under 3-lb. pressure to the tar extractors. After the tar is removed, the gas enters the secondary cooling tower, where the temperature is reduced to approximately that of the atmosphere before being delivered to the gas engines and to furnaces in the shops.

PRINCIPAL EQUIPMENT OF FORD CANADIAN PLANT

No.	Equipment	Kind	Size	Use	Operating Conditions	Maker
1	Gasteam unit	Gas and Corliss eng.	Gas, 42 x 72 in., steam 30 x 60 x 72 in.	Main generating unit	Steam 180 lb., 150 deg. sup., 80 r.p.m.	Hooven, Owens, Rentschler Co.
1	Generator	Direct-current	3000-kw	Main generating unit	Two-wire, 220-volt, 80 r.p.m.	Crocker-Wheeler Co.
1	Condenser	Surface	4900-sq.ft.	Serves gas steam unit		Wheeler Condenser & Engineer'g Co.
1	Pump	Centrifugal	3500-g.p.m.	Serves two condensers	Driven by 150-hp. Westinghouse d.-c. motor	Wheeler Condenser & Engineer'g Co.
1	Air pump	Edwards	18 x 12-in.	Serves 4900 sq.ft. condenser	Driven by 75-hp. Westinghouse d.-c. motor	Wheeler Condenser & Engineer'g Co.
2	Gas engines	Tandem-cylinder	24 x 36-in.	Drive a.-c. generator and air compressor	Suction producer gas, 160 r.p.m.	Hooven, Owens, Rentschler Co.
2	Air compressors	Single-stage	13 x 24-in.	Compressed air for shop	Driven by 24 x 36-in. gas engine	Hooven, Owens, Rentschler Co.
2	Generators	Three-phase, 60-cycle	500-kw.	A.-c. current for shops	220-volt driven by 24 x 36-in. gas engine	Crocker-Wheeler Co.
1	Gasteam unit	Gas and Corliss eng.	Gas 24 x 36-in., steam 18 x 34 x 36-in.	Drive a.-c. generator	Steam 180 lb., 150 deg. Sup., 100 r.p.m.	Hooven, Owens, Rentschler Co.
1	Generator	Three-phase, 60-cycle	1150-kw.	A.-c. current for shops	220-volt, driven by gasteam engine	Crocker-Wheeler Co.
1	Air compressor	Cross-compound engine, two-stage	Steam 27 x 36 x 24 in., air 13 x 26 x 24-in.	Compressed air for shops	165 r.p.m.	Hooven, Owens, Rentschler Co.
1	Condenser	Surface	4200 sq.ft.	Serves above two units		Wheeler Condenser & Engineer'g Co.
1	Air pump	Edwards	12 x 10-in.	Serves 4200-sq.ft. condenser	Driven by Westinghouse d.-c. motor	Wheeler Condenser & Engineer'g Co.
1	Turbo-generator	Three-phase, 60-cycle	375-kw.	A.-c. current for shops	220-volt, 3600 r.p.m.	Westinghouse Electric & Mfg. Co.
1	Condenser	Surface	800 sq.ft.	Serve turbo-generator		Westinghouse Electric & Mfg. Co.
1	Pump	Centrifugal	7-in. suction	Serve condenser	Air and condensate pump on same shaft; turbine driven	Westinghouse Electric & Mfg. Co.
4	Boilers	Water-tube	380-hp.	Generate steam	180 lb. gage, 150 deg. superheat	Badenhausen Co.
2	Boilers	Water-tube	500-hp.	Generate steam	180 lb. gage, 150 deg. superheat	Badenhausen Co.
6	Stokers	Taylor underfeed	5 and 7-retort	Serve boilers	Driven by motor	American Engineering Co.
2	Pumps	Reco-Roturbo	8-stage, 250-g.p.m.	Boiler feed	Driven by 60-hp. Westinghouse D.C. motor	Manistee Iron Works Co.
2	Gas producers	Suction	50 tons coal per 24 hr.	Gas to engines and furnaces	Six transverse sections, each own grates and air	Smith Gas Engineering Co.
2	Exhausters	Two-impeller	45.2 cu.ft. displ.	Serve producers	60 to 120 r.p.m.	Connersville Blower Co.
2	Twin engines	Corliss	11 x 24-in.	Drive exhausters	60 to 120 r.p.m.	Hooven, Owens, Rentschler Co.
4	Cooling towers	Stetic		Coal gas	Each has three water sprays.	Smith Gas Engineering Co.
3	Conveyors	Belt and cont. bucket	40 tons per hour	Coal from car to bunker	Motor-driven	Link-Belt Co.
1	Crusher	Hammer	40 tons per hour	Crush coal for boilers	Motor-driven	Williams Patent Crusher & Pulverizer Co.
1	Ash conveyor	Steam-jet vacuum	6-in. pipe	Remove ashes, boilers and producers		American Steam Conveyor Corp.

Badenhausen superheaters, Copes feed-water regulators, G.E. switchboard; Richardson-Phenix oiling and filtering system.

from 6 to 15 ft. long are used, so that the grates at various points along the incline may be reached. A bar of the right length properly used obviates holes low down in the fuel bed. Efforts are made to keep the fuel bed a dark cherry red in color, as it has been found that the fire in this condition produces the best results.

In the two producers now in service the stokers are located at the side and discharge at the top of the incline, the fuel sliding down on the grates as the ashes and clinkers are removed. In the third unit, which is now being installed, the stoker has been placed nearer the center and may be rotated by means of a handwheel so that the fuel may be fed to any part of the bed.

Exhaust steam is used to saturate the air blast to the producers. A thermostatic valve automatically controls the steam supply so as to maintain the temperature of the blast at 140 to 150 deg. Fahrenheit. When the temperature runs below 140 deg., there is liable to be clinker trouble, and on the other hand, if it exceeds 150 deg. the percentage of carbon dioxide in the gas increases, with a consequent lowering of the heat content.

In the operation of the thermostatic valve a curious phenomenon was discovered. The valve had been adjusted to open and close slowly, gradually changing the quantity of steam being admitted to the producer. By regulating it so that it would open and close at the rate of two times per minute, admitting the steam in puffs, the proportion of carbon monoxide could be maintained at 25 per cent. and the carbon dioxide correspondingly cut down to 3½ per cent. The probable theory for this is that in the first place steam coming in contact with incandescent carbon forms water gas high in CO. As the motor-operated valve closes, the decomposition zone increases rapidly in heat, as only dry air is entering the combustion zone. When the valve opens, it allows a considerable quantity of steam to enter and strike the incandescent carbon, the action of which is to form water gas, with the result that the producer gas being made is high in carbon monoxide.

When the gas plant was installed, a 1-in. tar pipe incased in a 3-in. steam line was run from the tar pumps to the producers. Jacketing the tar pipe proved unsatisfactory, and it was found to be unnecessary, for when the tar was recirculated it became as fluid as machine oil. A 2-in. line without steam-jacketing is now used, and the pumps were replaced by a steam-pressure tank. Steam at 880-lb. pressure is turned into the tank to force the tar to the spray nozzles over the producer fuel beds. When the supply has been exhausted, the steam sweeps the tank and the pipe free of tar instead of allowing a small remaining portion to congeal, as in the case of a pump and an unjacketed tar line. During the heavy load period of the day shift, 950 gal. of the tar is returned to each producer. The condition of the fuel bed during this period is more favorable to the efficient disposal of the tar.

At first, difficulty was encountered with the fuel bed becoming saturated with tar under the sprays. Increasing the number of spray nozzles from three to five overcame the trouble by distributing the tar more evenly over the fire. To get good results, the tar must be handled intelligently. It cannot be pumped on a hot or loose fire nor on a cool fire. The fuel bed must be compact and in good shape, and the gas leaving the producer should be at a temperature of from 1000 to 1200 deg. If the tar is sprayed on a very hot fire, the system will plug with lampblack and tar will saturate quickly a cool fire bed.

As far as known, this is the first time in the history of the industry that tar has been successfully disposed of in producers. Although the results have been satisfactory, it is felt that they would have been better were it not that the coal pile was burning underneath and some of it contained a large percentage of ash. With good coal the gas averaged over 180 B.t.u. per cu.ft. for more than a month, and several times went over the 200 mark, the highest value being 232 B.t.u. per cu.ft. This was made on Dec. 3, 1917. The sample was taken at 11 a.m. with the exhauster running at full load at 120 r.p.m. The accompanying table gives representative analyses when burning different qualities of coal with and without tar. The effects of tar and ash on the heat content of the gas are apparent. The tar return has the effect of reducing the percentage of hydrogen and at the same time increasing the methane.

The gain in thermal efficiency by gasifying the tar averages from 8 to 9 per cent. This varies a little according to the coal being used. For the past three months the producers have been using run-of-mine coal on account of the screening arrangement in the new coal-handling equipment now being completed.

When the plant was first started up last year, a temporary arrangement was set up to screen the coal. It was found, however, that after the crews got organized and knew how to handle the producers, they were able to get rich gas even with a considerable amount of slack in the coal. Herein lies the main factor contributing to uniformly successful results—the training of the operating force.

A gas-producer fireman is a rare species, and it is invariably necessary to hire inexperienced men and teach them. The cross-section drawings, Fig. 12, showing three conditions in a producer fire, was made up in colors for this purpose. It was hung in the gashouse to show the firemen what kind of a fire is necessary to make good gas. This graphic demonstration has been especially useful in the case of foreigners, many of whom did not understand a word of English. In this work the previous experience gained in the Detroit plant was used to full advantage.

Everything depends on the chief operator thoroughly understanding the fundamental essentials and being able to train his men accordingly. With this faculty and a full knowledge of the many pitfalls to be avoided, the attainment of topnotch efficiency and high-heat-value gas is an easy matter. With inexperienced or careless operators lean gas is invariably the result and the troubles in the plant multiply like compound interest. The operating expense rises and the output goes down. Overloads have the same effect and are to be avoided whenever possible.

The gas-producer log, Fig. 13, is interesting. A report of this character is turned in by the operator in charge of each shift when he goes off duty. It enables the chief operator to know conditions covering the full 24-hour period.

It was found that running 16 hours a day the gas engines and heat-treating furnaces combined were more than the gas plant could take care of at one time. This

condition was remedied by running a night shift on the furnaces to distribute the demand for gas more evenly and allow the producers to operate 24 hours per day.

It is interesting to note that the gas engines, which had previously operated on natural gas, took up full load on producer gas without any trouble. The conversion of the heat-treating furnaces and brazing burners was equally successful. The natural gas contained about 1000 B.t.u. per cu.ft. as compared to an average of, say, 190 B.t.u. for the producer gas.

GAS FROM GOOD COAL WHILE GASIFYING TAR
Coal Averaged 12 Per Cent. Ash

CO_2	CO	O	H	CH_4	B.t.u
5.30	25.80	0.1	9.78	6.36	190
5.6	22.60	1.0	1.90	11.80	208
4.5	19.20	0.5	3.00	12.53	208
5.3	22.60	0.9	3.78	10.40	200
4.4	22.40	0.4	6.50	12.60	232
3.0	19.8	0.2	12.31	9.23	207

GAS FROM GOOD COAL, NOT GASIFYING TAR
Coal Averaged 12 Per Cent. Ash

4.8	24.2	0.8	10.79	5.60	180
3.8	21.8	0.4	11.80	5.90	178
2.8	23.80	0.4	15.60	3.90	178

GAS FROM COAL-STORAGE PILE ON FIRE, GASIFYING TAR
Coal Averaged 28 Per Cent. Ash

3.20	27.60	0.2	9.20	4.60	176
3.40	26.50	0.2	14.91	2.80	174
4.80	21.20	0.2	8.40	6.90	175

GAS FROM COAL, NOT GASIFYING TAR
Coal Averaged 28 Per Cent. Ash

5.80	21.80	0.6	16.61	1.92	154
4.60	24.60	0.6	12.45	3.74	168
3.60	25.40	0.4	16.90	1.20	160

Stack Dampers Versus Ashpit Doors

It seems a little strange how two persons or groups of persons sometimes arrive at conclusions entirely different or opposite, but if experiments are not carefully performed or practices are based on nothing definite in the way of tests, this is almost sure to happen. Apropos of the foregoing there are two methods of regulating furnace fires, or the rate of combustion in furnaces, as practiced by power-plant engineers and those engaged in operating low-pressure steam, hot-water or hot-air furnaces. The power-plant man will maintain that the stack damper is the thing to use and that air to the ashpit should not be restricted in any case, or under any circumstances; that the ashpit doors should be taken off entirely and thrown away. The heating-boiler man avers with equal positiveness that the ashpit doors should be used exclusively, or at least as the major means of regulating the heat produced. Indeed it is said that ashpit doors are fitted so closely by some manufacturers as to make a ground joint between the door and frame.

It is likely that there are several reasons for this difference in practice. We know that if a boiler furnace is operating at full capacity, burning coal as fast as is possible with the given draft, etc., and it is desired to check it, closing the ashpit doors converts it at once into a first-rate gas producer. In fact this involves the gas-producer principle, in which the fuel is heated and combustible gas driven off without coming in contact with air enough to cause it to burn. But, says the furnace man, open the furnace door and admit enough air to support combustion above the fuel bed. This would not be so bad for a while if just the right amount of air was admitted and as long as the furnace temperature remained high enough to cause the gas to ignite, but such a period would be short and the air requirement would diminish rapidly as less gas was generated, and again the furnace temperature would soon drop below the ignition point and the gas and air would pass up the chimney together without being burned.

The principle of furnace regulation by means of the ashpit doors is "dead wrong," but there are "extenuating circumstances" or reasons for the practice in heating boilers and also reasons why it is not so wasteful and vicious as in high-pressure power plants. In the first place the fire is usually not so hot, therefore the gas-producing period is not long. Again, the draft over the fire is not strong—often less than 0.3 in.—so that there is not such a strong rush of cold air over the fire to chill it; and, since lower temperatures are dealt with, the bad effect is not so noticeable. In heating boilers the passages are usually short and direct and the maximum temperature within the boiler, if steam, is only about 240 deg. F. for 10 lb. pressure and in a hot-water boiler is not much over 200 deg. F. and often as low as 160 or lower. Therefore the heating boiler gets the benefit of the sensible heat at least, even when the furnace door is open, and the gas temperature may be quite low before there is an actual transfer of heat from the heating medium (steam or water) to the flue gas. Expedience is another big factor, as it is necessary to avoid gas in the basement of a residence. It is easy for the furnace man to persuade himself that any method of operation that keeps him out of trouble is right, and as a matter of course hot-air furnaces are less likely to discharge gas into the air ducts, when joints are not gas tight, by restricting the air entering, producing a lower air pressure within the furnace than by partly closing the stack damper. Unless the air pressure is lower in the furnace than in the furnace room or house ducts, there is likely to be an odor of gas in the house.

The United States Bureau of Mines makes the statement, as a result of numerous experiments, that it is practically impossible to force enough air through a bed of burning fuel to produce perfect combustion, therefore, without introducing air above the fuel bed there cannot be enough oxygen to combine with the carbon gas to satisfy it. This being true with a thin, active fire even with forced draft, it is the more important to see to it that some air is admitted above the fuel bed in a heating furnace carrying a deep bed of fire and considerable ash; a depth of 16 to 20 in. is recommended by some. This particular feature is the basis of the claims for fuel saving by the use of certain devices to be attached to furnace doors through which air is admitted and heated before reaching the furnace or combustion space. The same effect is produced to a certain extent by the baffle inside of the ordinary furnace door. The air entering through the register, in the furnace door, is heated by passing through the hot perforated baffle plate and is therefore in condition to ignite readily and does not chill the furnace below the ignition point.

The practice of regulating draft by closing the ashpit and opening the furnace door is entirely wrong when burning anthracite at a moderate rate in a low-temperature furnace, but is almost criminally wasteful when burning high-volatile fuel in a furnace involving high temperature and strong draft.

Dripping One-Pipe Steam-Heating Systems

By ALBERT L. BAUM

It is the purpose of this article to point out a few simple measures, which, if carried out at the time a heating system is installed, will tend to obviate all forms of noises and render quick heating an easy matter. They have been used in many installations and have been found satisfactory in every case.

WATER-HAMMERING and noises in steam-heating mains, risers and radiator connections are matters of such frequent occurrence that the average layman is disgusted at the mere mention of a steam-heating system, and sometimes when steam is turned on the wonder of it is that the radiator does not fly into pieces. There are also so many complaints of the length of time needed to get a room warm after steam is turned on that owners can hardly be blamed for "kicking" about the poor installation. The average person wants heat quickly without "kettledrum obligato." When the ideal condition is not realized, there is no end of trouble for everybody connected with the job, especially for the operating man. If quick circulation and the absence of noises were things unattainable, kicks would have no justification, but when both can be accomplished by the exercise of a little judgment, the perpetrator of these nuisances should be severely taken to task.

Circuit System of Steam Mains Wrong

In the first place, avoid using the so-called circuit system of steam mains. This is a system wherein the basement steam main is dripped only at its extreme end and risers are taken off at the top of the main. The pipe is, of course, given a little pitch downward toward the far end, so that the water of condensation will run off. The objection to such a system, shown in Fig. 1, is, that all the condensation opposes the steam in returning from the risers, falls back into the main directly across the flow of steam and collects in the bottom of the main. At points where the size of the main is reduced, at the riser branches and the reducing tees, water-pockets are formed. It is this comparatively large volume of water in the system that interferes with quick circulation and if, as is usually the case, the steam picks up part of the water and pushes it along, the system is subjected to water-hammer and banging as the water body comes up against sharp turns in the piping. The small sectional view within Fig. 1 shows the conditions as described, with the return water from the riser falling across the main steam flow.

An improvement on this layout, but only a slight one, is to split up the steam main into two or more sections and drip the end of each section, as shown in Fig. 2. By this means each section becomes shorter than in Fig. 1, and each carries a smaller amount of condensation. The improvement is brought about by making the travel of the condensation shorter before being drained out. The main can also be given a greater unit pitch because of its shorter length, thus allowing a more rapid removal of the condensation, and because of the smaller initial sizes of mains there is less reduction, hence not so many water-pockets. All these things make for a more rapid circulation and less noise.

Separate Return Main to Boiler

The best way to get out of trouble is not to get into it. Similarly the best way to get out of the troubles caused by an accumulation of water in a steam main is not to let it get into the main; and this is accomplished in a one-pipe system by running a separate return main back to the boiler, as shown in Fig. 3. With this method the steam riser is taken off at the bottom of the main at an angle of 45 deg., and the riser branch is pitched downward toward the heel of the riser, as shown in elevation within Fig. 3. From the riser heel, a connection is taken to the "wet" return line that is run below the water line in the boiler. The advantages of this method are: (1) The water pockets in the tees of the main at the points where the pipe size is reduced are eliminated; (2) the main is dripped at each riser branch; (3) each riser is dripped back into a line whose sole function is to carry return water and not steam; (4) no horizontal piping carries water flowing in the opposite direction to the steam; (5) no steam can flow through the return mains to pick up water and cause water-hammer.

The direct results are obvious: The steam main, being cleared of condensation, carries much drier steam; there being no water in the lines to oppose the flow of steam, the circulation is far more active; there being no water to be carried along with steam, the circulation is noiseless. The cost of this one-pipe system with wet returns is, of course, a little more than the circuit system, but the benefit derived from more rapid and noiseless circulation makes up many times for the slightly greater initial cost.

When Return Main Is Above Water Line

It is sometimes found undesirable or impractical (due to structural conditions) to run the wet-return line at the floor, as is the common practice. In such an event either an artificial seal can be made at the relief connection of each riser, or the return line at the ceiling can be artificially sealed. Fig. 4 shows the water seal at the base of the riser. The method of connecting the riser branch to the steam main is the same as in Fig. 3. The water of condensation, however, by collecting in the seal until it overflows into the return main at the ceiling, affords the same advantages as in Fig. 3. The seal should be about three feet deep to afford a sufficient head of water to prevent steam from blowing through. A draw-off cock should be provided at the bottom of the seal for draining the water when the system is shut down.

Another satisfactory arrangement where the return main cannot be run below the water line is illustrated by Fig. 5. Here the main itself is sealed, but the seal is provided with a bypass valve, which is opened to break the seal and drain the main when the system is to be emptied. An air valve at the top prevents

possible air-binding, and a dirt pocket at the rise of the seal acts as an accumulating chamber for pipe scale, etc., which might otherwise tend to clog up the line.

It is often found necessary to provide the basements or cellars of buildings with heating surface in addition to the piping, and where it can be done it is desirable to hang the radiators on the walls rather than the ceiling, as this affords much better heat distribution. This can be done with a wet-return main as shown in Fig. 6. Here the riser relief acts as the source of steam supply for the basement radiator. By connecting the radiator as shown, steam is supplied to it without in any way interfering with the drainage of the riser. It is merely necessary to observe the precaution of keeping the bottom of the radiator a little above the boiler-water line (18 to 24 in.) to guard against a possibility of water backing up and flooding the radiator. Water will back up a little on account of the pressure drop in the steam main, but where the piping is large enough, backing up is minimized. With the piping and basement radiation arranged as shown, a system of piping over 200 ft. long circulated noiselessly and heated up quickly with only ½ lb. pressure at the boiler.

While the foregoing measures will greatly improve the average one-pipe job, it must be borne in mind that the up-feed principle cannot be guaranteed perfect when installed in tall buildings, since the water and steam flow oppose each other in the long risers. A tall building should, for good operation, have an overhead steam main (in the attic or roof space) with down-feeders, the lower ends of which serve as drips and not to supply steam.

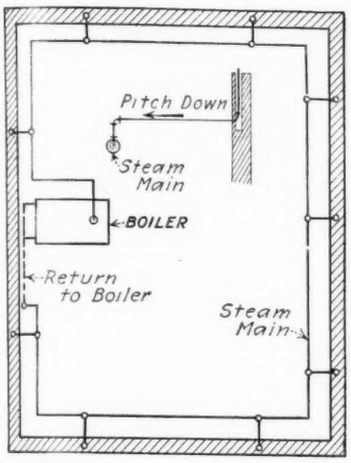


FIG. 1

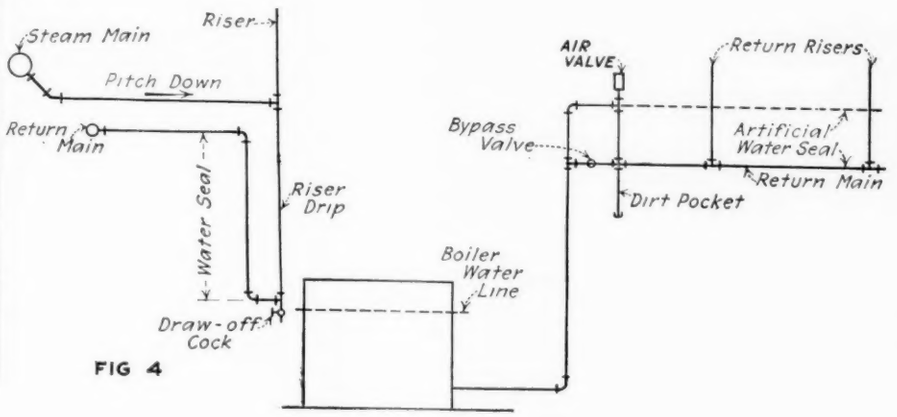


FIG 4

FIG. 5

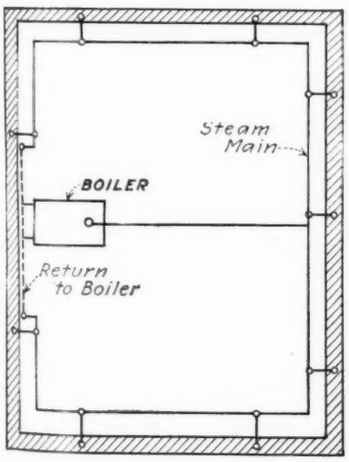


FIG. 2

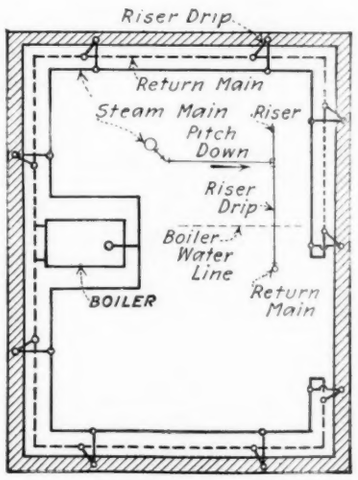


FIG. 3

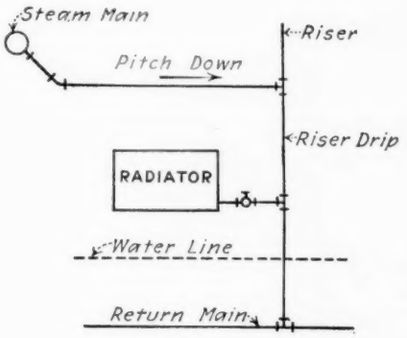


FIG. 6

FIGS. 1 TO 6. STEAM SUPPLY AND RETURN PIPING FOR A ONE-PIPE SYSTEM

Fig. 1—The "circuit" steam main and detail of riser connection. Fig. 2—The "split system" drained at two or more points. Fig. 3—Separate return loop draining each riser, and detail of connection. Fig. 4—Overhead return with water seal at each riser. Fig. 5—Overhead return with single water seal. Fig. 6—Basement radiator connection.

After working on nearly all the bearings on an ice machine in the combination ice and electric plant of the utilities company at Broken Arrow, Okla., the engineers decided that the knock for which they were looking was located elsewhere. It was difficult to believe, however, that the trouble was not in one of the bearings, because the knock sounded just like the noise a loose bearing usually makes. With these bearings all tight, however, additional search was made, and the trouble was found to be caused by the flywheel, which was beginning to work loose. Tightening the flywheel to its shaft cured the knock.

Some Features of Low-Compression Oil Engines—II

By L. H. MORRISON

In the present article the author discusses pistons and connecting-rods, the relative advantages of different types, troubles likely to occur, and their remedies.

WHILE the majority of the two-stroke-cycle engines of the low-compression type use pistons having deflector lips, similar to Fig. 1, a number use straight-faced pistons, somewhat like Fig. 2. If the air ports enter the cylinder at an angle, the latter type is as effective as the former. The operator should see that the clearance between piston and cylinder wall does not exceed 0.008 in.; that is, the difference in cylinder and piston diameters should not exceed 0.016 in. This clearance value is considerably greater than in either the gasoline or the Diesel engine. However, owing to the heat conditions in the cylinder of this type of engine, the piston expansion is considerable.

When wear increases this clearance, the rings will not be able to hold the compression, and loss of power results. If this loss becomes appreciable, it is advisable to install a new piston and rebore the cylinder. Most builders furnish replacement pistons from $\frac{1}{8}$ to $\frac{1}{16}$ in. oversize.

Where the cylinder walls are not scored or worn out of round, reboring is unnecessary. In this event the engineer will probably have to put the new piston in a lathe and finish it to the correct gage. This operation need not be dreaded; the main thing is to exercise great care in centering it in the lathe. After taking the finishing cut on the piston, it is well to file the surface to a smooth finish; the use of emery cloth to follow up the work of the file is also a good plan.

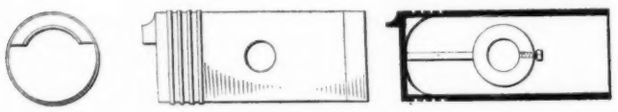


FIG. 1

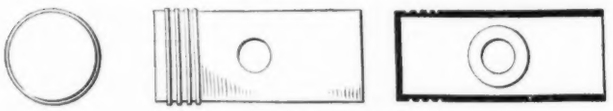


FIG. 2

FIGS. 1 AND 2. TYPES OF OIL-ENGINE PISTONS
Fig. 1—Piston with deflector. Fig. 2—Plain type

One encounters a great many cases where the cylinder is badly scored and where the operator cannot account for this damage, he being insistent that the piston has been supplied with plenty of lubrication. Usually, investigation reveals that the piston walls are not strengthened by supporting ribs, and the piston pin is locked at both bosses by setscrews or similar devices. If the piston pin becomes heated, it will lengthen, and where there are no ribs to resist this force, the thin piston walls assume an elliptical shape. This always results in the cylinder cutting along the sides in line with the piston pin. If the operator finds that the piston is built along these lines, it is well to file a flat surface on the piston around the pin. Then in case of elongation this clearance will allow the piston to change its shape without damaging the cylinder.

Where the damage already exists, it is not always necessary to rebore the cylinder even though the scoring be deep. If the scoring or cutting is limited in area and does not extend along the entire stroke, the damage can be remedied by using an emery stone and a file. In such instances good results are obtained by

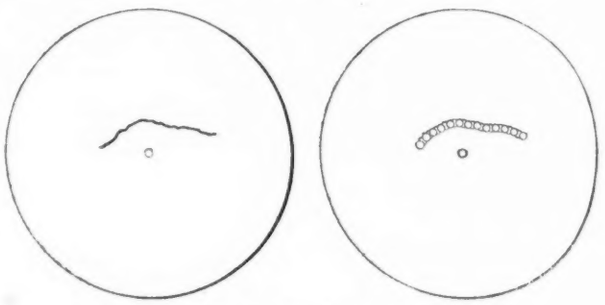


FIG. 3. REPAIR OF A CRACKED PISTON

first using an emery wheel held in the hand. By rubbing the scored spots in this way, the rough ridges are removed, and a fine file and an emery stone will smooth the work. This process has been used in many instances where the cylinder looked hopeless.

In cases of worn rings the best plan is to replace them, since their continued use means loss of power. There is the further disadvantage that the play that these worn rings will have in the grooves will cause the groove to wear so that a standard-size ring will not fit.

Frequently, these new rings are made at a local shop. In this event it is good practice to have the uncut ring rough-turned to an outside diameter about $\frac{1}{16}$ in. larger than the cylinder. The ring should then be cut and, after being clamped to the diameter desired, finished both inside and out. This method insures a ring that will hug the cylinder walls at all times. Moreover, the ring should be as wide as the groove.

Another frequent cause of a worn piston is the distorting of the exhaust-port bridges. These bridges or bars are not as easily cooled as the remainder of the cylinder, and often show a tendency to elongate, with consequent bulging, so that the under side of the piston strikes them.

The cylinder should be inspected at least every sixty days, and if the port bridges seem bright, the piston will probably be found cut to some extent. The remedy is to file and rub these bright spots until the piston clears them. At these inspections the piston should be pulled and the rings examined. If badly gummed, kerosene will usually loosen them. If this is not successful, place the piston in strong lye.

The expansion of the piston head often causes minute fire cracks to appear. Frequently one of these will develop into a well-defined crack several inches in length. Usually this extends entirely through the head and allows the gases to blow through, resulting in decreased power. The tendency of the inexperienced engineer is to replace the piston at a heavy cost. This replacement is entirely unnecessary in the majority of cases. Fig. 3 shows a piston head with quite an extensive crack. In repairing this, a row of ¼-in. holes is drilled in the head and tapped, about ¾ in. center to center. One-quarter-inch brass screws are then screwed into these holes. A second row of ¼-in. holes is drilled between the screws in the first row. These holes are tapped, and brass screws are inserted. This entire row of screws is cut close to the head and riveted over This "sewing" will cure any crack that does not extend over one-half the diameter of the piston. This method is used by a power company possessing twenty Diesels, and it is entirely satisfactory.

Connecting Rods for Low-Compression Engines

Figs. 4 to 7 show the types of connecting-rods generally used on the low-compression engines. Fig. 4 has a marine-type crank end and a round nonadjustable piston-pin end. As the latter has no means of adjustment, the engineer should not allow this solid end bearing to become too worn; prompt replacement by a new bushing will help maintain a smooth-running engine.

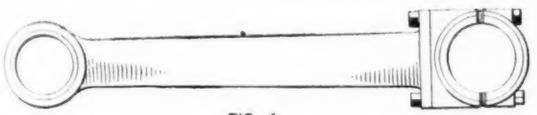


FIG. 4

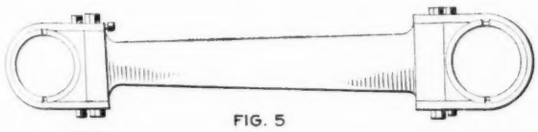


FIG. 5

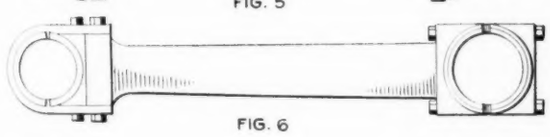


FIG. 6

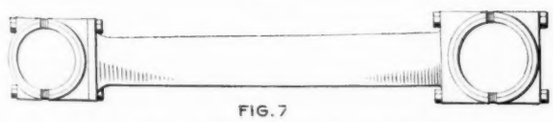


FIG. 7

FIGS. 4 TO 7. TYPES OF OIL-ENGINE CONNECTING-RODS

Fig. 5 shows a rod having a wedge adjustment at both ends, while in Fig. 6 the rod has a wedge at the wristpin end and a marine-type box at the crankpin. Fig. 7 shows a rod used on some engines with both ends of the marine type.

In operation all play should be taken up. If the wrist end has a wedge or screw adjustment, it is an easy matter to take up the lost motion without dismantling the engine. The same applies to the crank end, regardless of the particular type of bearing. However, if the wrist end be a marine-type box, it will be necessary to pull the piston in order to get at the box. In making adjustment at the wristpin end, the box should be taken up until the rod will move freely, yet not show any evidence of play between the box and the pin. The crank end should be tightened up until the engine can just be turned over with the starting bar.

Probably the oiling of the wristpin box has caused more trouble and worry than all the rest of the engine. Some builders depend on picking up enough oil from the cylinder walls to lubricate the pin; usually this does not occur, and a troublesome pin results. A second method is to have a pipe passing through the cylinder

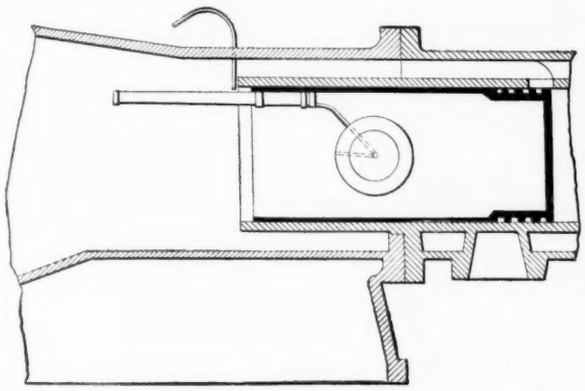


FIG. 8. LUBRICATING A WRIST PIN BEARING

walls, allowing the oil to be picked up by a small groove on the piston. A third is to supply the pin through a hole in the connecting-rod. Probably one of the best ways on horizontal engines is to use a device such as a wick oiler in connection with a mechanical oil pump.

A contrivance the writer used on an inclosed-frame engine is outlined in Fig. 8. This engine always had a hot wristpin bearing, and it was traceable to lack of oil. A 1¼-in. brass pipe was first slotted on one side and both ends capped. This pipe was fastened to the inner wall of the piston, extending out 16 in. beyond the cylinder end. A ¼-in. connection was made to the pin boss, thence to the pin through a drilled passage. This 1¼-in. pipe received the oil from a tube connected to the oil pump and mounted on the engine frame just in front of the cylinder. Since the slot was as long as the engine stroke, oil supply to the pin was positive.

The piston-pin bearing or box is usually made of phosphor bronze—a babbitt bearing will not stand up very well, because of the heat conditions within the piston. It is well to remember that it is not necessary to have this bearing completely surround the pin. The pressure actually falls on a very small portion of the bearing, and the lubrication is better with part of the bearing cut away, as shown in Fig. 9. Frequently the manufacturer does not do this, and the engineer should remove the surplus portion before using the bearing.

The crankpin bearings used on this type of engine up to 75 hp. are usually split babbitt bushings inclosed in the bearing housings or boxes. Ordinarily, the manufacturer die-casts these bearings and reams them out to size. With this kind of bearing, in case of renewal, the cheapest way is to buy a new one from the engine builder, since the plants using these smaller engines are not equipped, as a rule, to make these bushings. In case of urgency, where it is impossible to wait for the new bushing from the factory, it is often possible to have the local foundry cast a new bushing, using the old parts as a pattern. The engineer should see that the machinist who fits this bushing to the

engine uses considerable care in bringing it to a perfect contact with the pin.

On the larger engines the removable bushing is seldom used. The crankpin bearing housing or box usually is made of steel or cast iron, the former being the better. This box is lined with babbitt, and the best babbitt is always the cheapest in the long run.

Frequently one encounters a crank box that will not

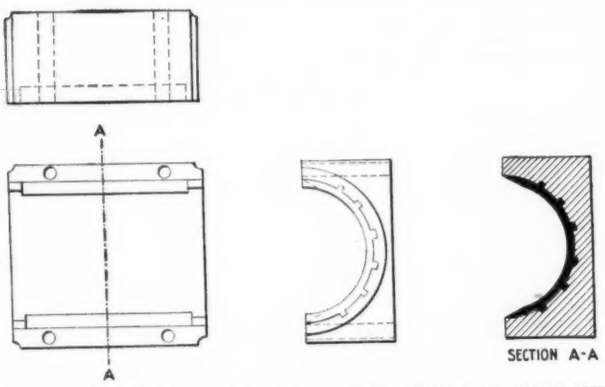


FIG. 9. CUTTING AWAY EDGE OF BEARING TO IMPROVE LUBRICATION

retain the babbitt. The fault usually proves to be the lack of sufficient anchorage in the bearing. If the box is merely drilled in a number of places for babbitt anchors, it will be well to put it on a planer or milling machine and cut dovetail slots in the surface. These slots will hold the babbitt under unusually severe conditions.

In rebabbitting a box it is never advisable to run it with the box cold. If this is done, the babbitt will seldom unite with the box. The best method is to first heat the box until it becomes almost cherry red; then retin the surface, place the mandrel in position and cast the bearing. It is never advisable to use the crankpin as the mandrel. The better way is to use a mandrel slightly smaller in diameter than the pin, and then bore the babbitt bearing to the correct diameter.

It is of no benefit to peen the surface of the babbitt. This practice is likely to loosen the bond between the babbitt and the cast-iron box. After reboring the bearing to the correct diameter, the two halves should be lightly coated with prussian blue and placed one at a time upon the pin. By rotating the half of the bearing the engineer can see where the high spots are and scrape the bearing to a perfect contact. This scraping is a tedious affair, but the resultant long life of the bearing justifies the labor.

As regards the amount of side play between the bearing and the crank web, this should be just enough to allow a small pinch bar to barely give the box a lateral motion—not more than $^1/_{64}$ of an inch.

The bearing should fit the pin snugly and allow the piston to be "jumped" a slight amount—probably 0.002 in. Any new crank bearing is likely to run warm for a while, but the engine should not be shut down as long as the babbitt does not run. The best way is to run the engine without load for a couple of hours. Then stop and inspect the boxes, both wristpin and crank.

Outdoor Water-Cooled Transformers

By R. VON FABRICE

Consideration is given to the necessary equipment to properly handle the oil and to furnish a suitable cooling-water supply for outdoor water-cooled oil-insulated transformers.

WITHIN the last few years the installation of outdoor substation equipment has received considerable recognition, due partly to the high cost of the construction materials required for substation buildings and partly to the great increase in both capacity and voltage of electrical distribution and transmission equipment, necessitating excessively large buildings to provide the proper clearances. It must not, however, be forgotten that the cost of buildings is not entirely eliminated by the installation of outdoor equipment, as it is partly offset by the greater cost of apparatus installed and the necessary steel frame work.

For outdoor transformers where attendance is available, water cooling is the most practical from a financial and operating point of view. However, it is necessary to take precautions to provide such transformer installation with all equipment that may be required for safety in operating the equipment.

The proper installation of outdoor water-cooled transformers requires the most careful consideration of all the factors involved, such as the right arrangement and protection of piping, adequate supply of water and necessary drains and drips, as well as suitable means for filtering and handling the oil in the transformers in case of emergency. The water problem in itself is probably of most vital importance to the proper operation of the transformers.

The supply of suitable water as well as its cost are the first consideration. Water that is dirty or polluted with chemicals or sewage is unsuitable unless the coils in the transformers are specially made to meet the requirements. City water is prohibitive in cost, if not saved and reused. Rivers, wells or lakes are usually the best sources from which to obtain fresh water.

With an abundance of water free of cost, the only apparatus required is a circulating pump to force the water through the transformers, letting the overflow run back into the stream, lake or sewer as the case may be. For a well-water supply with no sewer available or other source of discharge, the water from the transformers may be piped to another well spaced about fifty feet from the supply well, which will take care of the overflow.

If city water only is available, in addition to the pump a cooling tower should be installed in order to reuse the water, using the city water for makeup purposes or emergency service only, sewer connection

or discharge piping to a suitable place to be provided and arranged to bypass the tower. All installation should be provided with an emergency-supply connection, either city-water line, service connection from overhead tanks or duplicate pumps.

To insure against stoppage in the transformer coils, all water should pass through a strainer before entering the piping system or transformers. To prevent freezing, all water piping must be carried below the frost line in the earth and protected with a housing or boxing where the line leaves the ground to the transformers and cooling tower.

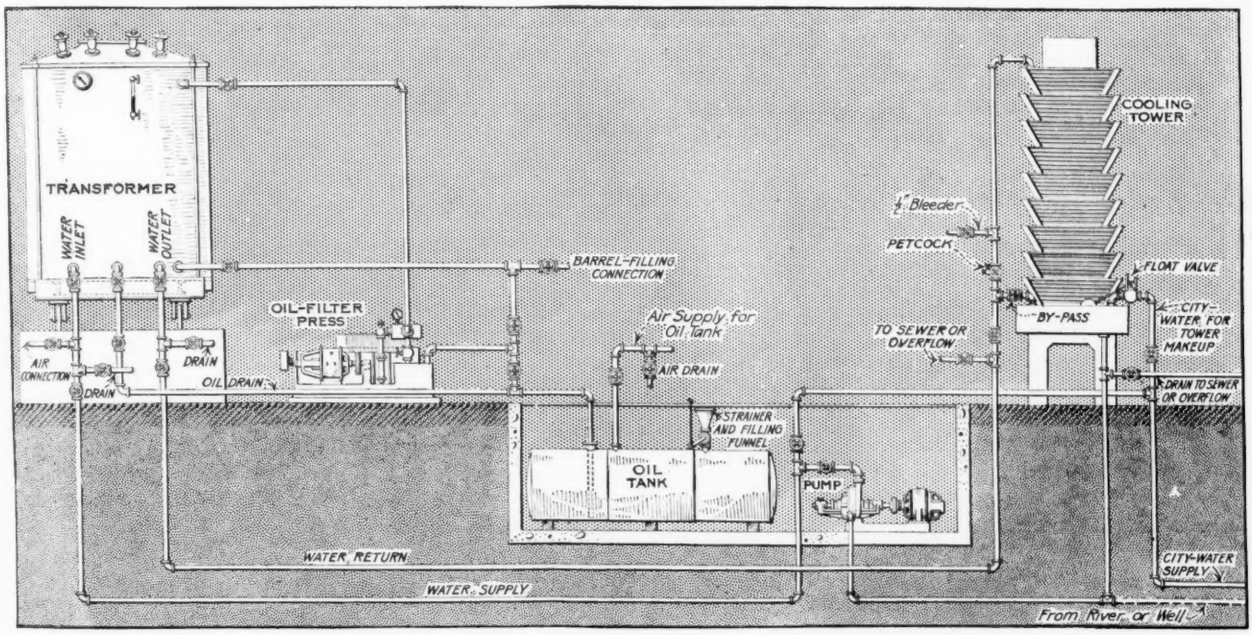
It is a good plan to provide compressed air to blow the water out of the transformer coils along with valves and drains suitable for the purpose, because if the transformers are out of service in cold weather the water will freeze in the cooling coils and cause serious delay and expense to make repairs. The air is necessary to blow the water out of the transformer cooling coils, since they will not drain completely, which, unfortunately, is an inherent fault in transformer construction.

Oil tanks, either of concrete or steel, should be provided and so located that the oil from the transformers can readily be discharged to the tanks by gravity. The tanks should also be arranged so as to be accessible for filling from barrels, and there should be connections from the transformers so that the oil can be discharged into barrels when it is desired to change it.

The figure shows a typical water-cooling system for a transformer and the necessary equipment for an installation to fulfill the foregoing requirements. When the supply of water is from city mains, it flows from the cooling tower to the pump then through the transformer's cooling coils and back through the water-return line and up to the cooling tower and thence back to the pump, to be reused. The water pipe at the cooling tower is arranged to bypass the tower, which is necessary in cold weather to prevent freezing. A drain is provided at the shut-off valve in the pipe to the top tower to drain the water in this vertical pipe to prevent freezing. A city water makeup line to the cooling tower is provided with a float valve to supply the water lost by leakage and evaporation.

The line from the cooling tower to the pump is also equipped with a drain or overflow to provide means for completely draining the cooling tower in case the pump should break down. With a cheap source of water such as a well or other than city-water supply, the cooling tower and its piping are omitted and the water from the transformers is allowed to flow overboard.

Air connections are placed on the water-inlet end of the transformer coils to provide means of blowing out the water, the proper valves and drains being provided as shown.



PIPING LAYOUT FOR TRANSFORMER COOLING-WATER SYSTEM, USING COOLING TOWER

Means for rapid discharge of the oil from the transformer in case of fire is provided as indicated by locating a steel or concrete tank below the level of the transformers. Filter-press connections should be provided in order to enable the oil in the transformer to be cleaned, which can be accomplished with the piping as shown. The oil can either be filtered direct from the transformer, or, if desired, drawn from the receiving tank.

In steel-tank installations an air supply can be used to force the oil from the receiving tank into casks. In this case the pipe must enter the tank to within about two inches of the bottom, as shown, in order that the oil may be forced out of the tank. The strainer in the filling funnel at the top of the tank is so located that oil barrels may be rolled over it and the oil poured into the tank. A quick opening and closing valve is placed in the bottom of the funnel, arranged to be operated from above.

Visits of Inspector Brown—XXXII

By J. E. TERMAN

In which Brown is told what economizers are, why cast iron is a better material for tubes than steel, and is shown the different methods of securing the tubes to the headers.

WHEN Brown came into the office after finishing the day's work, he looked through the glass partition into the Chief's room and noticed that he was alone. As soon as he had washed up, he presented himself to the Chief and announced that he was ready to go on with the explanation of what an economizer was.

"I will start with first principles," said the Chief, "at the risk of telling you a lot of things you already know."

"That's all right, Chief; you may think that I know things about these 'push-nipple cast-iron boilers' that I really don't know at all," said Brown.

"There are two makes of economizers that you will find in your travels around the country," said the Chief. "These look very much alike, and there is practically no difference between them except in regard to a few of the details of construction. Both are made up of sections of tubes, these sections being from four to twelve tubes wide. The tubes are about 4½ in. in external diameter, and generally about 9 or 10 ft. long. A single economizer will contain from 400 to 13,000 sq.ft. of heating surface and of course a lot of water, which is the interesting feature to us if it is allowed to become highly heated. The tubes are about ⅜ in. thick, and made of cast iron, which is the material used almost exclusively in the construction of economizers."

"Why is cast iron used instead of steel, Chief?" asked Brown.

"Well, the primary object, no doubt, was to get a material that would resist corrosion. In the early days of economizer operation, pressures were generally moderate, and cast iron was no doubt felt to be good enough for the purpose, and probably cheaper than steel."

"Why is it more necessary for the material in an economizer to resist corrosion than in a boiler?" asked Brown.

"You know, Brown, from your own inspection experience, that when feed water is introduced into a boiler at a point where circulation is sluggish, severe corrosion is almost sure to occur. This corrosion is supposed to be mainly due to gases from the air which are dissolved in the water. The gases that are supposed to cause most of the trouble are oxygen and carbon dioxide. If the water is brought up to the boiling point before being put into the boiler, the gases are driven off and corrosion avoided. I don't mean by this that it is merely necessary to raise the temperature to 212 deg. F. If this temperature is reached in a closed vessel under a pressure of, say, 20 lb., boiling will not occur and the gases will not all be driven off."

"But they would be driven off in an open feed-water heater, eh?" asked Brown.

"Yes, that is one of the advantages of the open heater. On the other hand, you have to be careful to get out the oil that the exhaust brings in. We are getting away from our subject, though. The reason why an economizer is required to resist corrosion, is that the circulation is sluggish, and severe corrosion is likely to happen both inside and out. If the water fed to an economizer is too cold, the outer surfaces of the tubes and headers sweat, at least at the entrance end. The manufacturers of economizers usually recommend that the temperature of the water which is intended to be fed to an economizer be not less than 100 deg. F., in order to prevent sweating of the tubes. The gases from the furnace of a boiler carry more or less sulphur, and in combination with moisture sulphurous acid is formed. This, of course, tends to produce severe external corrosion.

"Since cast iron is the material used for the tubes in economizers, it would not be practicable, as you can see, to expand them into the headers, as would be the case in boiler construction. It is also impracticable to screw the parts together, as in pipe work; at least I have never heard of a vessel of this character being built in that way," said the Chief. "If the parts should be screwed together, it would be impossible to renew single tubes. The parts are merely pressed together, and reliance is placed on rust and friction, notwithstanding the fact that the material used is notoriously inelastic and cannot be counted on for much gripping action."

"Say, Chief, before we go any further, I would like to know why boilers, made up of good cast-iron headers and with steel tubes expanded and flared in them, should be limited to a pressure of 165 lb., while an economizer, with the parts merely pushed together, is allowed any old pressure?"

"Well, in the first place, notwithstanding my definition, an economizer is not a boiler but a heater, and so long as it keeps on being a heater and doesn't try to be a boiler, it is perfectly safe. The high pressure is produced by the pumps pushing water through it into the boilers, and even if it does rupture, it won't produce an explosion if the water isn't over 212 degrees."

"But some of them heat the water up around 300 deg.," said Brown.

"Yes; and then there will be trouble if anything breaks. Those rust joints, though, will hold under an enormous pressure if they are handled right."

"Why couldn't the tube be tapered this way (drawing *A*, Fig. 1) and put in from the top? Then the header couldn't pull off."

"Well, one type of economizer makes a move in that direction, but the taper is only about an eighth of an inch in a foot. You can't see it by the eye."

"Why don't they make it steeper?"

"I should think there would be considerable difficulty experienced in any attempt to do that, Brown. If you have eight or ten tubes to be pressed into a rigid header and have the connection tight after the opera-

tion is completed, the slightest difference in the size of the openings in the header, measured through any plane parallel to the length of the header, or the slightest difference in the diameter of the tube ends, measured at the same distance apart between the ends, would seem to make the connection impracticable, if a sharp taper was used. Therefore, the tube ends and the holes in the headers into which they are pressed, must be almost cylindrical rather than conical. You understand, Brown, that I know nothing about building economizers, but I can see lots of trouble in any attempt to make a sizable taper for the tube ends.

"However, whatever taper there is at the top tube ends, in the case of your sketch (*A*), tends to cause a tightening of the connection between the parts with any tendency of the top header to slip off the tubes. The taper at the lower ends of the tubes in *A* is in the same direction as at the top. In this case," drawing *B*, "you will notice that the taper at the bottom and that at the top ends of the tubes are in opposite directions, and the slightest movement of the header at either end tends to loosen the connection between the parts. The typical economizer explosion is produced by the separation of the tubes and headers."

"Well, if I should have to make any push-nipple connections, Chief, I would want those tube ends cylindrical,

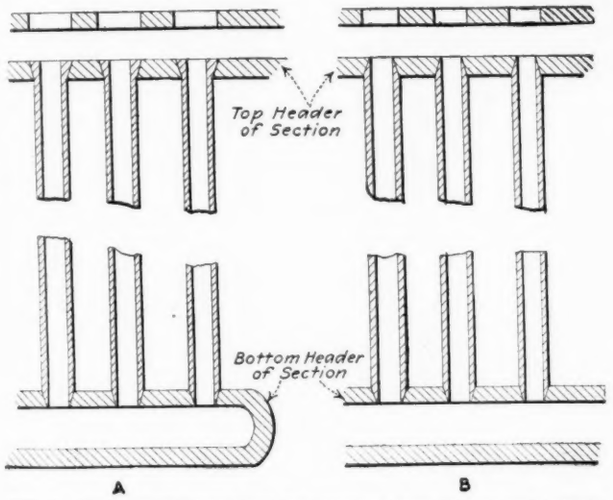


FIG. 1. TWO METHODS OF SECURING TUBES TO HEADERS

if my experience with car wheels is to count for anything," said Brown.

"As I told you the last time we were talking on this subject," broke in the Chief, "the counter-current principle is often used in economizer operation, the water entering the cold end next to the stack and flowing toward the hot end. Now, there are a number of different methods of circulation used in practice——"

"My! Chief, do you know what time it is? The madam will certainly be waiting supper for you."

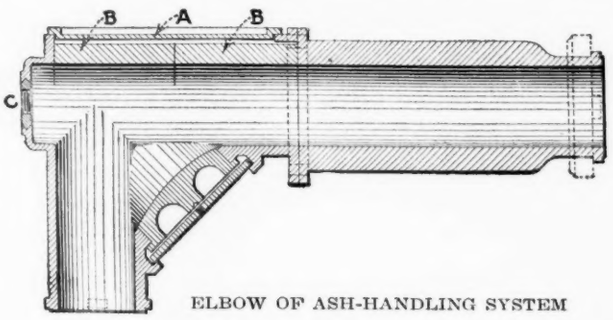
"Well, it is late; come in tomorrow, Brown, and we will take another turn at this economizer thing," said the Chief.

Production of bituminous coal during the week of July 20, while not equivalent to the record week of July 13, was higher than any previous week, being estimated at 12,950,000 net tons, as against 13,273,000 net tons during the week preceding.

Brady Steam-Jet Ash Conveyor

The accompanying illustration is a cross-section of the 90-deg. nozzle-carrying elbow and the wearing section attached to its discharge end used in the steam-jet ash conveyor made by the James A Brady Foundry Co., of Chicago, and described in the Apr. 17, 1917, issue of *Power*.

The improvements made consist of a cover plate *A* running the full length of the elbow, two-piece interchangeable liners *B*, each 2 in. thick, and a cast-iron insertion *C* in the hard Brady metal body so that the



ELBOW OF ASH-HANDLING SYSTEM

tap for the nozzle may be easily made. The inner turn of the elbow has an easy curve in which is an arched inspection door 10 in. across. Beyond the elbow is the wearing section with walls 2½ in. thick. At the elbow end this has a square flange and at the other end a loose flange, so that the section can be turned four times before removal from the pipe line. It will be noticed that full inside diameter has been maintained in the elbow and wearing section.

Aspects of Dams

Where through long use, an owner of a dam has acquired the right to maintain flashboards on it, thereby increasing the overflow of upstream lands, he is entitled, in reconstructing the dam, to build it to a height including that at which the flashboards have been maintained. So holds the Iowa Supreme Court in the recent case of Watters vs. Anamosa-Oxford Junction Light and Power Co., 167 Northwestern Reporter, 765.

The court also holds that the mere fact that a new dam backs water farther up a river than its predecessor does not establish a wrongful increase in the height of the structure. Whether there has been a wrongful increase must appear from the depth of the water impounded and from a comparison of the old structure with the new as to height, etc.

In another case—Wapsipinicon Power Co. vs. Waterhouse, 167 Northwestern Reporter, 623, the same court decided that where a permanent dam is constructed, a riparian owner injuriously affected immediately becomes entitled to enforce a claim for the difference between the market value of his land flooded by the dam immediately before and immediately after flooding. But it is held that this right does not pass to a subsequent purchaser of the land by virtue of his purchase under a warranty deed, especially where the seller has settled with the dam owner on account of such damages. And if there has been such settlement, it makes no difference whether it is evidence by agreement in writing or by word of mouth, so far as concerns the purchaser's rights.

Changing Power-Plant Shifts

By J. C. HAWKINS

Arranging the various shifts of a power-plant force is one of the problems the chief is obliged to solve. To suit everyone interested is sometimes difficult. This article tells how a schedule of change of watches was arranged in a plant employing three shifts, each working eight hours.

IT IS seldom two power plants can be found that are operated in the same manner, and the method of handling the men requires that the individual characteristics of the plant be taken into consideration. Power-plant employees are generally required to work seven days a week, although there is no good reason why this should be the rule, and if they were allowed one day off each week, or every two weeks at the outside, there would be a marked increase in the efficiency of the plant as the men would be better satisfied and more attentive to business.

Any chief engineer realizes that two or three dissatisfied men can unintentionally cause the employer much expense through their not having the interests of the company at heart, and many little things are slighted which in the end amount to considerable.

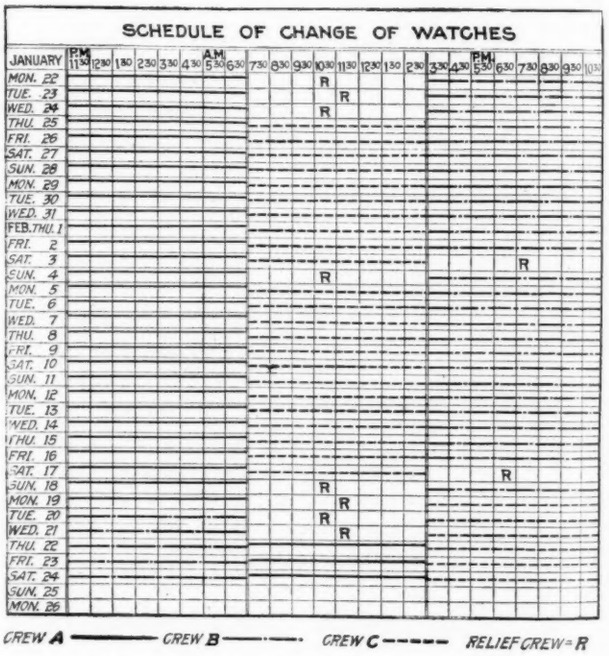
Where the plant operates 24 hours per day there should be three watches of eight hours each, and except in small plants an extra, or relief man, who can be called upon in case a man is absent on account of sickness, and also to take the place of the regular men when they have their days off duty. In order to give each man the same working conditions, it is necessary that they change watches at regular intervals, because day work is, as a rule, more desirable than night work, and it requires as high-grade license to operate the plant at night as during the day. If there is to be any discrimination in wages, it should be in favor of the night man, although this is not usually the case, and frequently the reverse is true. I have in mind a plant at the Government Printing Office, Washington, D. C., where the night men receive 20 per cent. more than the men on the day shift, doing the same work. This applies not only to the power plant, but to other departments as well.

Excepting in large plants having regular repair men the repair work should be divided so that each engineer will be responsible for a certain part of it. This plan has the advantage that work can be allotted to the man who is best fitted to handle it. For instance, one may be better trained to take care of turbines, while another would be better on boilers, pumps, generators, etc., depending on his training and ability. Some engineers work up from the boiler room, others from oiling, some from the machine shop or electrical repair shop, and each has certain qualifications that may not always be found in the others although, generally speaking, one may be as good an engineer as another.

This plan is carried out along the following lines at the National Museum, Washington, D. C. There are three watches, with one engineer, one fireman and one coal passer on each watch. There is one boiler cleaner working days only, who also acts as a relief fireman; two oilers who do not change, there being no oiler from midnight to 8 a.m.; a relief engineer, who takes care of the steam-heating system when not doing relief duty in the engine room; a machinist, who sometimes relieves in the engine room; and a blacksmith, who sometimes relieves in the boiler room in case of sickness.

The watches change at 7:30 a.m., 3:30 and 11:30 p.m., on account of the car service at night, and change shifts every four weeks. Each man has one day off every two weeks except members of the first watch, who have two days at the end of the four weeks, with an extra day off every twelve weeks, as shown hereinafter. All the men on each watch excepting the oilers change watches at the same time, except in case of sickness.

The method of changing is shown graphically in the accompanying chart, in which the three crews are designated as *A*, *B* and *C*. The men do not overlap, although each man aims to be on duty from ten to twenty minutes before relieving time. The chart shows the actual time worked by each shift between Jan. 22 and Feb. 26. On Saturday, Feb. 3, crew *B* were off and the relief crew worked from 3:30 to 11:30 p.m., coming back at 7:30 a.m. the next day (Sunday) and working until 3:30 p.m. to relieve crew *C*, who were off on that day. Then the regular men were on duty on their regular watches until Saturday, Feb. 17, when crew *B* were off, the relief men taking their places, crew *B* coming back on Sunday on the same watch (from 3:30 to 11:30). On Sunday, Feb. 18, crew *C* were off duty, being relieved by the extra men, and came back Monday at 3:30 p.m. Crew *A* worked each day from 11:30 p.m. to 7:30 a.m., from Monday, Jan. 22, to Monday, Feb. 19, inclusive, when they were relieved by crew *B*, who took that watch and crew *A*



WATCHES CHART AND KEY TO CREWS

had two days off, Wednesday, Feb. 20 and 21, coming back Thursday, Feb. 22 at 7:30 a.m. During these four days, Feb. 18-21, the relief men were on duty from 7:30 a.m. to 3:30 p.m., as shown. It will also be noticed that crew *B* got off at 11:30 p.m. Sunday, Feb. 18, and came back at 11:30 p.m. Monday, so that they also had 24 hours off duty, which one crew gets each time the watches change. The holidays are divided so that each crew get their turn, including the extra men, although sometimes more than one can be excused. Sometimes the chief stands one watch to let more men off, especially Christmas and New Year.

When not on duty in the plant, the relief fireman cleans boilers, weighs coal, etc. The relief engineer takes care of the heating system in distant buildings, does pipe work, and in warm weather operates a small refrigerating plant located in a distant building, used for scientific purposes. The relief coal passer assists in cleaning about the building, helping the blacksmith and doing other outside work. The oilers are off each alternate Sunday and do not change. They also have each alternate holiday.

With the schedule arranged in this manner, each man knows when he may expect to be off duty and can look forward to it as a time in which he can attend to private business. These arrangements are of course subject to interruption in case of sickness or other emergencies.

This plan does not involve any extra expense for the relief men, as there is a certain amount of work to be done in the heating and lighting department during the year and a certain number of men to do it. If one or more are off duty, the others have to work a little harder to make up for it, so that in reality each man makes up for the time that he is off duty, although in Government service his hours are restricted to eight in each twenty-four.

Although this seems to be an expensive plan of employing men and does make the labor cost high, current is delivered to the switchboard for an average of about two cents per kilowatt-hour the year around and for less than one cent during the winter when the exhaust steam is used for heating. This is not bad for an 800-hp. isolated plant when all things are considered.

Exciter Turbine Accident at Gorge Plant, Akron, Ohio

An exciter turbine for a 20,000-kw. main unit overspeeds, apparently owing to the governor-valve stem being bent so badly as to prevent the closing of the valve. The automatic safety stop was adjusted to permit overspeed, and the throttle was blocked open with a piece of wood to avoid automatically stopping the turbine. The rotor burst through the casing, killing one man and injuring another.

IN THE issue of July 23 appeared a news item relative to the wreck of an exciter unit turbine at the Gorge power house of the Northern Ohio Traction and Lighting Co., Saturday, July 6. The following is a more complete account of this mishap:

The accident to the turbine occurred on Saturday, July 6, at about 11:20 a.m., the turbine overspeeding, the rotor breaking through the casing and pieces of the turbine hitting Clyde A. Gilmore, commercial engineer, Westinghouse Electric and Manufacturing Co., Pittsburgh, seriously cutting him about the limbs and back. Mr. Gilmore died from the injuries received. T. J. Stewart, a switchboard operator in the plant, was hit with flying pieces of the turbine, but his life was saved probably by the presence of his watch and a truss which he was wearing.

On Sunday, June 23, the Westinghouse turbine, which drove an exciter for a 20,000-kw. unit and which was geared, was shut down to clean the oil system, which necessitated the removal of the gear case and the disconnecting of the governor and governor valve. It was in operation from this time until Sunday morning, June 29, when it was again shut down to clean the generator. This work finished, the unit was again put in service, but was stopped almost immediately by the automatic stop governor operating, due very likely to overspeeding of the turbine. To keep the turbine running a washer about $\frac{1}{16}$ in. thick was put under the automatic stop-governor spring, the object being to make the automatic stop governor operate at a higher than usual speed. Upon again starting the unit the automatic stop again operated, again stopping the turbine. So far as can be learned the automatic stop governor was

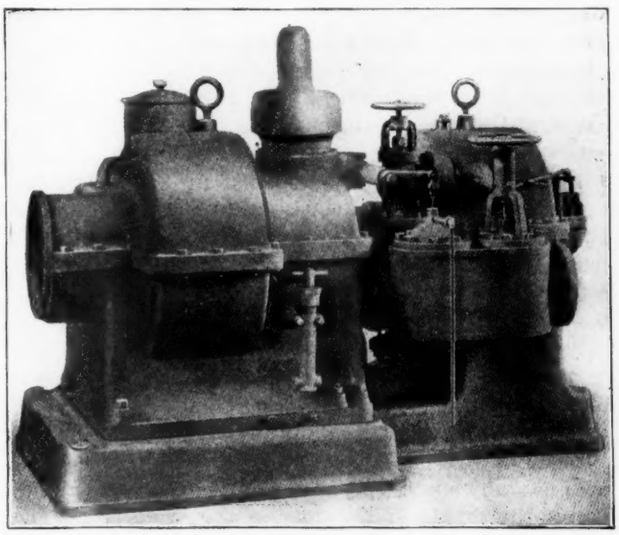


FIG. 1. TYPE OF TURBINE WRECKED AT GORGE PLANT, AKRON, OHIO

functioning as it should; that is, the turbine was overspeeding. The type of turbine is shown in Fig. 1.

Referring to Fig. 2, the governor valve is shown at the extreme left, the automatic throttle valve next to it, and the automatic stop governor and part of the knock-off lever are shown at the right.

It is said that the rod reaching from the automatic throttle valve of the automatic stop governor, to which the knock-off lever is attached, was lengthened by adjustment. The rod was lengthened a distance equivalent to one-half turn of its threaded ends, the turbine started up, and the automatic stop governor again operated. The rod was lengthened another half-turn, the position of the knock-off lever probably being such that the automatic stop governor was thus adjusted so that it was impossible for the governor weight to strike the knock-off lever. After this last adjustment the unit was again put in service and continued in operation until the accident of July 6.

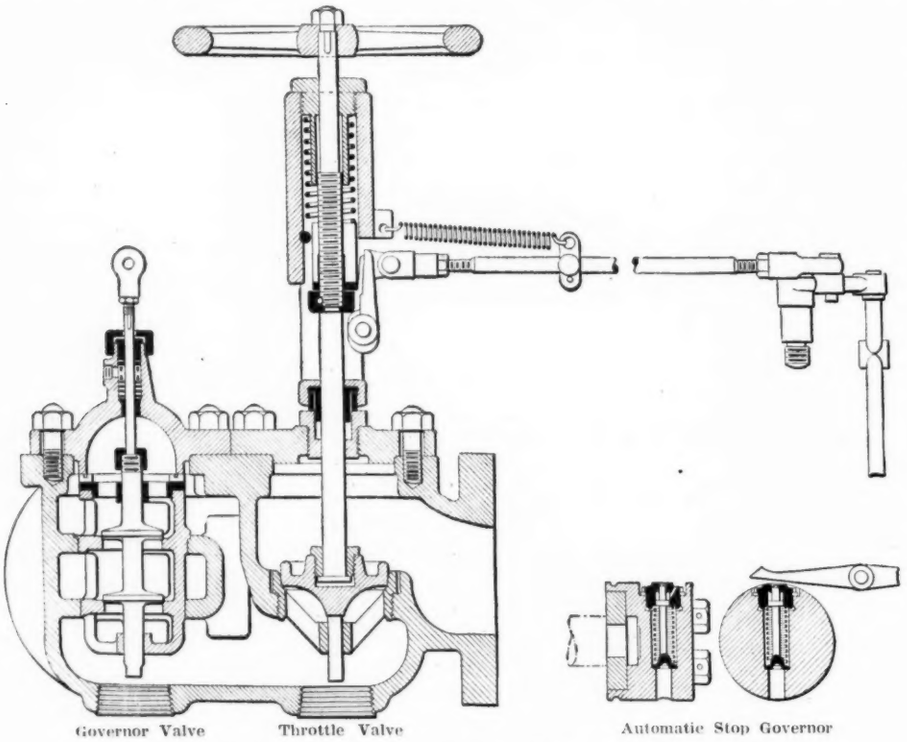


FIG. 2. SECTIONS OF GOVERNOR AND THROTTLE VALVES AND AUTOMATIC STOP GOVERNOR

Before the wreck it is stated that the governor valve stem was found bent so much that the stem prevented the valve from further closing and shutting off the steam to the turbine. It is also said that the automatic throttle valve was blocked wide open with a piece of wood so that it was impossible for it to automatically close. The valve was probably blocked open by the operating crew, fearing that the automatic stop governor might again operate, throwing the unit out of service, which would in turn throw the main unit out of commission and thus interrupt service on the line, which the operating force wished to avoid. During the time that the turbine was in operation the automatic stop-governor weight was coming in light contact with the automatic stop knock-off lever, indicating that the turbine was running above speed.

Just prior to the wrecking of the turbine one of the operating engineers is said to have begun to close a globe valve in the steam line to the turbine; this is a valve other than and in addition to the automatic throttle valve. It seems that during this time the speed of the exciter unit was increasing and continued to do so until the rotor burst through the casing. It is said that an examination of the turbine after the accident showed that the pinion shaft had broken outside of No. 1 pinion-shaft bearing, and that the bolts which held the extension shaft at No. 1 bearing were sheared. The gear case was broken where the pinion shaft passed through, the bedplate at the turbine end was broken, the cylinder or turbine casing broken in pieces, and all the blades in the turbine rotor were damaged. A piece of the turbine passed through the power-house roof and side wall. Examination of the automatic stop governor showed that the weight was broken in two pieces, but whether this occurred before the accident or after it is not known. The governor-valve stem was found to be bent. The governor valve was tested to determine whether it was steam tight, and it was said to be leaking sufficiently to allow the unit to overspeed on light loads. A small piece of metal was found in the bottom of the steam chest, which could have lodged between the valve and seat, allowing the valve to pass enough steam to cause overspeeding, but whether this metal did or did not hold open the seat is not known. It is likely that it did not. Ordinarily, at about 10 per cent. above normal speed the weight in the overspeed governor flies out and trips the automatic throttle, shutting down the turbine. These small turbines usually have a speed of 3600 r.p.m.

For What Shall It Profit a Man?

For What Shall It Profit a Man
if he shall selfishly become rich and opulent at the expense of industrial home work, and lose his honor and betray his sons and brothers to the enemy?

For What Shall It Profit a Man
if from any motive he shall delay work bearing directly or indirectly on the war, and thereby act as an accessory to the murder of his fellow Americans?

For What Shall It Profit a Man
if he shall increase his wages and decrease his working hours, and contribute to the victory of a nation that makes slaves of white men and scourges them as they work?

For What Shall It Profit a Man
if he shall strike while this war is in progress, and win, and forge his own future shackles by contributing to the success of an autocracy to whom he is but a clod of earth?

"For what shall it profit a man if he shall gain the whole world and lose his own soul?"

EDITORIALS

The Turbine Accident at Akron

EVIDENTLY there is a lesson for operating men in the wreck of the exciter turbine in the Gorge plant of the Northern Ohio Traction and Lighting Co., Akron, Ohio, described on page 203 of this issue. In the last analysis the accident, which killed one man and injured another, seems to have been due to the operating force accepting the hazard of taking a chance in order that service might not be interrupted.

The exciter unit was turbine-driven through reduction gears. The operating force seems to have been given repeated warning that a dangerous condition existed; but instead of correcting the cause of the trouble, the automatic safety stop was adjusted to prevent its weight being thrown out so that it might strike the trip lever that released the automatic throttle valve, which, had it functioned, would have stopped the flow of steam to the turbine and avoided the high speed that caused the loss of life and wrecked the turbine. Another unfortunate circumstance is that the throttle is said to have been held open by a block of wood placed there for that purpose. This, of course, made useless the automatic safety stop.

The machine had been partly dismantled previous to the accident, and the governor-valve stem may have been bent in the course of the operation. In any event the turbine ran continuously up to this time. Examination of the governor valve after the accident is said to have revealed that it would not close and that it would pass enough steam to overspeed the turbine on light loads. The automatic safety stop functioned several times, shutting down the machine each time, and after each shutdown the safety stop was adjusted so that greater speed was required to make it trip the automatic throttle. The rod connecting the safety stop and the throttle, which causes the former to release the throttle, was lengthened, evidently making it more difficult for the throttle and safety stop to properly function, at least before a dangerous speed was reached. In spite of these repeated warnings the turbine was not taken off the line for examination to determine and correct the cause of overspeeding. From what we can learn it is evident that if the governor-valve stem had been straightened, the wreck would have been avoided, provided of course that the throttle was not blocked open and that adjustment of the safety stop was as it should have been.

The lesson again is that it is foolish to take chances with such machinery when there are repeated warnings that some vital part is not functioning as it should. Most of these small units are alike in that certain precautions must be religiously observed if accidents are to be avoided; and it is the business of the engineer to see that they are observed. For example, with units such as these, the packing or the condition of the governor rod must not be permitted to become such that the rod may stick and hold the valve from its seat. The valves should be ground and kept free of scale so that no foreign substances will allow them to pass steam when they are supposed to be closed. And as for blocking open the automatic throttle, that is indeed too hazardous to be done by sensible men or for the management to force their men to resort to avoid a shutdown. Engineers are not called upon, except in most unusual circumstances, to knowingly place their lives and other persons' property in jeopardy to avoid a few minutes' or hours' interruption to the service of a particular unit or to that of the whole system.

A Chance To Win an Indicator

IN THE recommendations accompanying its questionnaire to the owners of power plants the Fuel Administration has carefully avoided the mention of specific apparatus or processes. With the exception of its mention of a well-known pipe covering, the nearest that it has come to this is to remark, in connection with its recommendation that combustion be checked by analyzing the flue gases, that "suitable instruments are available at from fifteen to twenty-five dollars." This latter was necessary, as many owners and some operators of steam plants would have little idea as to what was necessary or available to carry out the recommendation.

Most of the recommendations have to do with the making of steam, comparatively few with its use. A letter on page 207 calls attention to the fact that great economies are to be effected by resetting the valves of engines, pumps, compressors, etc. The indicator is a potent aid in tuning an engine up to its maximum efficiency and keeping it there, and the Trill Company, in order to bring out some of the improvements which have been effected by its use, offers in this letter to present an indicator to the one reporting the most meritorious use of an indicator on a steam engine and another indicator to the one reporting the most meritorious use of an indicator on a pump, compressor, gas or oil engine or apparatus other than a steam engine. A planimeter is offered as a second prize in each of these cases. Each instance must be real, illustrated by actual diagrams and attested by the owner or manager of the plant in which it occurred.

Who better than the president of the American Society of Mechanical Engineers, the advisory engineer of the Fuel Administration, and the chairman of the A. S. M. E. Committee on Power Tests could decide the relative merits of the cases submitted, and what body of men could render a decision that would be accepted with more confidence and respect? *Power* is fortunate in having obtained the consent of these eminent engineers, occupying respectively the positions mentioned —Charles T. Main, David Moffat Myers and George H. Barrus—to serve as judges and now invites those who have had experience in the use of the indicator to send in accounts of the instance of its most meritorious and effective use, which has come within their ex-

perience or observation, illustrated with actual diagrams and attested by some responsible authority at the plant where the application was made. Address them to the Editorial Department of *Power*, and they must be here before November first to be eligible.

Teamplay Has Come To Stay

ONE of the most valuable byproducts of the Great War is the new conception of teamplay which it has brought home to countless thousands of individuals hitherto unaccustomed to think in terms of the common good. The most casual reader of the thrilling story of the conflict need not be told that without coöperation to the "last full measure of devotion" not a battle could be won on land or sea. We see this quickly enough in its relation to military operations, but not always do we appreciate its equal importance in the less spectacular work behind the lines. The farther away one gets from the sound of the artillery, the greater is the danger of forgetting, for a time at least, that one's responsibility in daily humdrum service has a vital bearing upon the success of the cause. This danger is rapidly being overcome, we rejoice to say, by publicity in various forms; but here and there outbreaks of disturbance in the industrial world on this side of the water as well as abroad show that a good deal is yet to be learned regarding the subordination of the individual to democracy's welfare. Wholly apart from the causes of these disturbances, which should be considered and settled on their merits without interruption of production in war time, enters the need of getting a correct perspective of the relations of men to their tasks and to one another.

This perspective shows at once that the time has gone by when narrow and petty outlooks can be permitted to retard progress. Patriotism asks today that men "put up with" more inconvenience and discomfort in their daily life than would be tolerated in peace times, and they are doing it. It asks that the chip-on-the-shoulder attitude be discarded for the duration of the war, and it is "up to" us all to apply this in our individual lives. This is no time to harbor grudges against one's superiors; rather let us sink personalities in the tremendous struggle against the common enemy and give one another every possible aid. Subordinates should accept far more dictation and clamp the lid down tighter on their feelings than under conditions of normal human activity, even accepting a "bawling out" now and then which may not be wholly justified and not get "sore" thereby at the boss.

Too much insistence upon being required to do only one special kind of work; little-minded opposition to critical review of one's work by others; jealousy at seeing a younger member of the staff advanced beyond one's own post; balking at overtime work in emergencies; indifference as to the quality and quantity of one's output; lack of interest in the routine job, which must be done as well as the special investigation if the best results are to be attained, and too great absorption in the things lying beyond the immediate duty—all tend to hold back the work of the day. Willingness to share the credit of good work with others was never so important as now, and the free interchange of views with one's associates was never worth so much. The men at the front know the absolute necessity of teamplay; when they return victorious, as they will, in due time, they will sweep away extreme selfish individualism in the industrial life of this country, and now is the time to anticipate this change and to realize that teamplay has come, never to depart so long as the nation's heart and mind remain sound.

It seems that Los Angeles, California, is tied fast by contract or agreement to take twenty-five thousand horsepower from the Southern California Edison Co.; this power is produced from oil fuel, of which there is a serious shortage. If Chief Engineer Scattergood, of that city's Bureau of Municipal Light and Power, is correct in his statement that the city can, without serious delay and unwarranted expense, get an equivalent of this power from the San Francisquito Canyon, then the National Fuel Administration should aid Los Angeles with the same alacrity that the Administration's chief of light and power has espoused the cause of the large central station. It is economy to the nation that must be achieved now; not large dividends and unfair trade advantages.

Delegates to the coming National Convention of the National Association of Stationary Engineers will each be presented with a package of business cards bearing his photograph, name, address, business connection and association number if each will now send in his photograph—the three-for-a-quarter post-card size, head and shoulders only, and the other information mentioned. Have you sent in yours yet? Address, *Power*, Editorial, Tenth Avenue at Thirty-Sixth Street, New York City. These cards will make it easy for you to remember the faces and names of those new acquaintances you will make at the convention, and easy for them to remember you.

The United States Fuel Administration in coöperation with the United States Geological Survey, is compiling statistics of power development and transmission in private electrical plants. Each plant is asked to give particulars of its fuel consumption, steam production, prime movers, electrical generation, electric-energy account for 1917, electric-load data, steam-heating data, etc. It is hoped that the results of the investigation will overcome the obsession of some of the members of the Administration with regard to shutting down isolated plants.

We do not know the reasons that the boilermakers, who struck at Oakland, California, gave for their action; but we agree with Charles M. Schwab that it seems incredible that at a moment when the Germans were making a renewed drive against American soldiers in France, any body of American workmen could stop building ships for any reason whatever.

The Fuel Administration's power-plant questionnaire has been a veritable alarm clock for many engineers and plant owners.

CORRESPONDENCE

A Chance to Win an Indicator

The Fuel Administration is doing a commendable work in insisting upon improved efficiency in power plants; but is there not a saving to be made in the use of steam as well as in the making of it; in the engine room as well as in the boiler room?

The questionnaire, as published in *Power* of June 11, recommends the use of CO_2 recorders on the boilers, but says nothing about the use of indicators on the engines.

In order to demonstrate to the Fuel Administration and others the magnitude of the savings which may be made by rectifying the setting of the valves of an engine, pump or compressor by the use of the indicator, we should like to offer through *Power* two indicators and two planimeters to be awarded upon such terms and conditions as the editor may define, as follows:

One indicator for the report of the case in which an indicator was most intelligently and to the best effect used upon a steam engine.

One indicator for the report of the case in which an indicator was most intelligently and to the best effect used upon an internal-combustion engine, a pump, an ammonia or air compressor, or in any service other than upon a steam engine.

One planimeter as a second prize in each of the cases mentioned.

The indicator is made with interchangeable pistons and cylinders adapting it to steam engines, gas or oil engines, ammonia compressors, etc., and the winner may have large or small cylinders, of steel or bronze as he prefers.

We shall be glad to leave the definition of conditions and the determination of the winners to the editor of *Power*, but the cases reported must be accompanied by a letter from the owner attesting their bona fides and illustrated by indicator diagrams.

The instruments are ready when you are.

TRILL INDICATOR CO.

[We shall be glad to act as the medium for the distribution of these prizes, and have obtained the consent of the following eminent authorities to decide as to the merits of the cases submitted: Charles T. Main, President of the American Society of Mechanical Engineers; David Moffat Myers, Advisory Engineer of the United States Fuel Administration, and George H. Barrus, Chairman of the Power Test Committee of the American Society of Mechanical Engineers. The award will be for what, in the opinion of the judges, is the most meritorious use of the indicator, and the cases submitted must be actual ones attested to by the owner or manager of the plant in which they occurred. No case will be considered which does not reach this office before Nov. 1. Cases which have actually occurred in the experience or practice of the sender are preferred, and care should be taken to include all of the essential data.—Editor.]

Simplified Power-Factor Formula

One of the great disadvantages that an engineer will find after a continued study of the theory of the apparatus under his care is his inability to apply his knowledge, owing to a lack of instruments and also to the use of formulas involving considerable computation in order to derive the desired results from data obtainable from those instruments available. If some of the formulas given in textbooks could be simplified so as to be utilized simply by resorting to mental arithmetic, without the need of tedious computations, more frequent use would be made of them, a greater knowledge of the operation and characteristics of the apparatus would be gained and a desire for still more knowledge would be awakened.

For example, a 2300-volt three-phase alternating-current system at times showed extremely poor voltage regulation, while at other times it was fairly good. The instruments provided were a voltmeter, a wattmeter and an ammeter in each phase. After a little study of the conditions the trouble was found to be due to a low power factor at times, caused by one or more induction motors running considerably underloaded. If the power factor was known at any instant, the whole situation would thus be made much clearer to the operator.

The formula for finding the power factor is

$$P.F. = \frac{W}{E \times \sqrt{3}\, I} \text{ or } P.F. = \frac{kilowatts}{kilovolts \times \sqrt{3}\, I}$$

in this case kv. = 2.3, and since the system is operating at constant potential, this should be the same at all times; then we get

$$P.F. = \frac{kw.}{2.3 \times 1.73 \times I} = \frac{kw.}{4I}$$

and to apply the formula simply multiply the ammeter reading by 4 (the load being balanced or nearly so) and divide the reading of the wattmeter by the number thus obtained. For instance, with the given voltage, we read 23 kw. and 12.5 amp., which gives us $P.F. = \frac{23}{12.5 \times 4} = 0.46$, or 46 per cent.

After a little practice this can be applied almost as quickly as the instruments can be read. For other voltages it will be necessary to find a new constant for the denominator of this formula. For instance, with 230 volts this will be 0.4, which gives

$$P.F. = \frac{kw.}{0.4I}$$

in which case it would be simpler to use

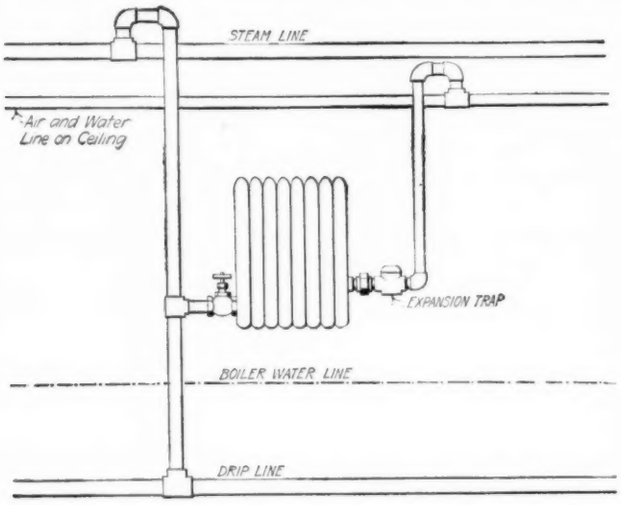
$$P.F. = \frac{2.5\ kw.}{I}$$

Any small error due to the use of this method may be disregarded, because the accuracy of switchboard instruments is not always very great.

Fortress Monroe, Va. JULIUS BRODSKY.

Radiator Connections

In reply to Mr. Ellison's letter on page 812 in the issue of June 4, asking for suggestions for connecting new radiators to a heating system, I would recommend connecting them as shown in the accompanying illustration. It is assumed that the air and water return



PROPOSED CONNECTION FOR BASEMENT RADIATOR

line on the ceiling carries at all times a lower pressure than that in the steam line. In radiator 2 in the original illustration the water was forced up from the drip line into the ceiling line as there was nothing to stop it, and in radiator 3 practically the same thing occurred, because the expansion trap did not get hot enough to close. Radiator 4 would be no different from radiator 3 if the steam inlet happened to be closed.

I think a practical solution would be to make those radiators that come below the ceiling line strictly "one-pipe" connected, as shown, making sure that the steam pipe to the radiator is sufficiently large. In this way the water in all parts of the system is kept in equilibrium as the steam pressure is on top of the water in every line, and the water from the drip line cannot come in contact with the expansion valve, which should be placed on the farther end of the radiator about one-third the way up from the bottom and connected to the ceiling line.

CHARLES A. ENGGREN.

Brooklyn, N. Y.

A Fair Attitude

I note your objection to the substitution of central-power current for the current from isolated plants. It does not seem to me, from the statements which have been made by the Fuel Administration that any superiority was claimed for either system. As Administrative Engineer I shall take the position that wherever the central station can furnish electricity, including a reasonable interest on the cost of making connections, at a cheaper rate than it can be made by the isolated plants the isolated plant should be shut down. Isolated plants which are found to be most inefficient should shut down first. If the isolated plant is able to use its exhaust steam and to the extent to which such use is efficient, it may be able to hold its own against the central plant, and in that event it should be allowed to run.

It is evident that during three or four months in the summer the isolated plant in many cases cannot compete with the large central station, especially if it has no condensers. In the cost of the large central station must be included the cost of distribution. This is often more than the expense of production of current, and evidently each plant must be judged in accordance with the conditions. It certainly would be unjust to make any sweeping rule including all plants. The Fuel Administration has certainly no desire to act for the benefit of anybody, and the Conservation Division and Administrative Engineer are organized to save fuel in order that we shall have as little shortage as possible.

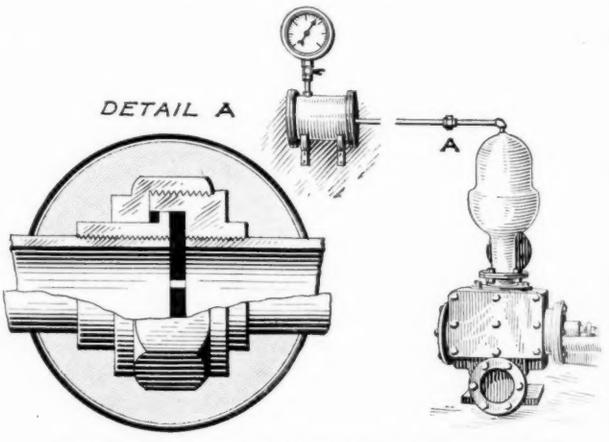
A cursory examination of the power plants in this state will convince anyone that many of them are very wasteful. Even the best of plants can make a saving of 10 per cent. in their consumption of fuel by more careful attention to detail and control. The problem is to convince the power-plant owner that his plant is not efficient and that it must be to his interest as well as to the public interest to use every effort to save fuel.

With the help of the engineering talent of the country the Fuel Administration hopes to accomplish something in this direction. I am glad to see that *Power* is taking such an active interest in helping to educate the power-plant owner.

EDWARD TRUMP,
Syracuse, N. Y. Administrative Engineer.

Pulsation in Pressure Gage Stopped

The illustration shows the means I have employed to prevent the pulsating action of a pump being transmitted to the pressure gage. It is the general practice to partly close the stop-cock under the gage in such cases, but the extremely small opening is in danger of



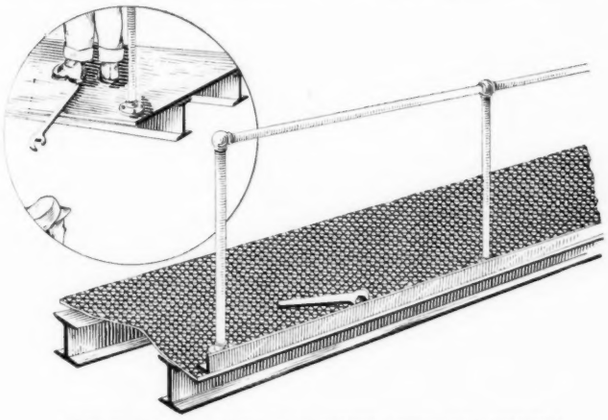
PRESSURE GAGE ON AUXILIARY AIR CHAMBER

being entirely closed by a small particle of scale or other foreign substance. By using a chamber beyond the restricted opening the desired dampening effect is obtained with a large opening, less likely to choke up. The reservoir I used would hold about three gallons and when attached to an 18 x 10 x 18 pump, with an opening $\frac{3}{32}$ in. in diameter in the diaphragm, clamped in the union, it allows the gage to stand "dead steady."

Phelps, Wis. PETER LE MOINE.

Elevated Platform Safety Guard

In connection with engines, switchboards, etc., having elevated platforms or stairways, it is advisable to guard against accidents from tools rolling or being kicked off the edge of the platform and injuring some person



ANGLE-IRON GUARD ON ELEVATED PLATFORM

or machinery below. An inexpensive but effective guard is made from 2- or 3-in. angle iron bolted to the edge of the platform, as shown in the illustration.

Philadelphia, Penn. M. A. SALLER.

Suggested Steam-Jet Ash-Conveyor Improvements

In the June 25 issue H. G. Burrill suggests the use of four nozzles in a steam-jet ash conveyor for the purpose of preventing wear. This idea has been tried out and found to be defective for the reason that unless the nozzles are skillfully designed and distributed, the steam consumption rises out of all proportion to the amount which would actually be required. Another objection to the use of four nozzles is the fact that eddy and reverse currents are developed, which tend to make the pipe clog much more easily than is the case where two or one jet only is employed. A patent was secured on a jet which would form a complete cone encircling the entire conveyor pipe. But this cone type of jet was found to be impractical, principally for the same reason that the use of four jets was found to be inefficient and objectionable.

Many investigations and experiments seem to prove conclusively that the use of two jets opposing each other in the side of the pipe is the most efficient and useful design. In this way the jet creates an even suction throughout the cross-section of the pipe and allows in the lower part of the pipe a free passage for the material. If four jets were used one would have to be located at or near the bottom of the pipe and the constant scrubbing of the ashes and other refuse over the jet would tend to wear it and destroy its efficiency. Hence in a short while the top jet would be creating a different pressure from the lower one, with the result that uneven wear would develop.

Mr. Burrill also says that the use of long-radius bends is more desirable than sharp 90-deg. bends. This statement is too broad and should be qualified to suit different local conditions. Where a large tonnage of ashes is being handled, it has been found that long-radius bends are susceptible of greater wear and produce no additional advantages to offset this feature. On the other hand, right-angle bends, when properly designed and installed, produced maximum service with a minimum of wear and replacement raquirements.

As a matter of fact each individual installation presents an engineering problem that is more or less radically different from other installations. For this reason it is impossible to make any general statement that will apply to all cases.

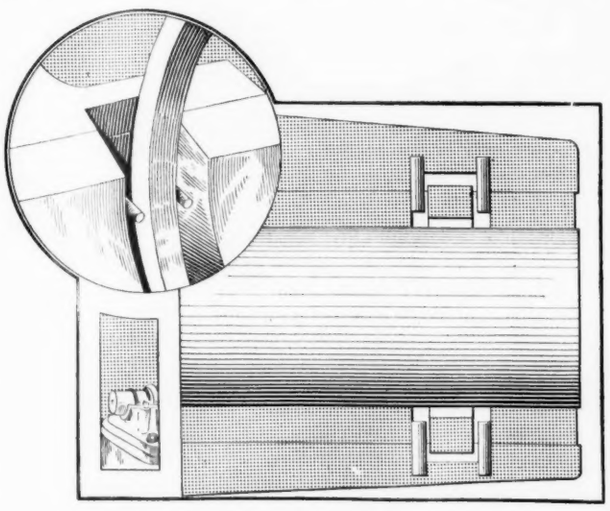
It is interesting to note that Mr. Burrill will install a skip hoist and tank ash-handling system, and that he aims to keep accurate records of the comparative cost of the two types of installation. In the interest of economical power-plant operation it is to be hoped that he will publish the figures after he has secured them.

Indianapolis, Ind. M. J. ARMINGTON.

Oil Rings Magnetized

The institution in which I am employed, is in an isolated place, with nearly a thousand persons dependent for all things on an uninterrupted service from the power department. Naturally, under such circumstances "kinks" will develop and have to be overcome. For example, one of our direct-connected machines had always given more or less trouble at the outboard bearing because the oil rings failed to turn freely, consequently the journal heated. We tried lighter oil and everything we could think of without success.

When taking this bearing down, I noticed that the box was slightly magnetized—enough to attract the rings, which were steel, against the sides of the slots and keep



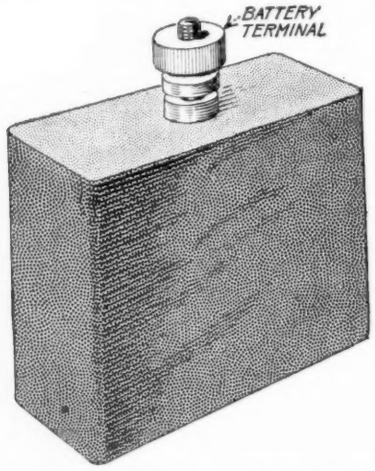
BRASS PINS KEEP RING FROM CONTACT WITH BEARING CAP

them from turning as they should. We drilled holes and put in brass guide pins to keep the rings central in the slots, and since then we have had no further trouble. While this stray magnetism is only small, it is enough to retard the rings considerably and probably stop them at times. I think it is poor practice to use a steel oil ring on bearings of this description. GORDON E. MANN.

Battleford, Sask., Canada.

Battery Carbon Brushes

Being in immediate need of a set of brushes for a small generator and not having a set at hand, I met the emergency by using the carbon electrodes from a number of old dry-battery cells. After removing the carbons, I used the ends with the terminal connection on, cutting these to the proper dimension with a hack-



BRUSH MADE FROM BATTERY CARBON

saw and finished the brushes up with sandpaper. What had been the connection to the carbon in the battery was made the connection for the pigtail to the brush, as shown in the figure. These brushes have been in use for a number of months and are giving perfect service.

J. F. POTTS.

Fort Pierce, Fla.

Supporting Effect of Boiler Heads

At first I was inclined to believe that Mr. Macdonald's article in the May 21 issue was putting the case too strongly; but a little figuring showed that his contention is substantially correct as far as it applies to short boiler stays. However, there are cases in which a pressure or load is sustained by two supporting members, where such a conclusion may not be true. His line of reasoning does not show this, and his statement is a little too general.

In any application of load to a beam or stay there is always a definite deflection or elongation that, within the elastic limit, is proportional to the load, although for small loads it may be almost immeasurably small. When pressure is generated inside a stayed boiler shell, the heads and stays stretch slightly according to the load that comes on them, until the total resistance balances the load due to the pressure, and its approximate distribution may be figured by comparing the loads that would produce the same distortion in boiler head and stay rod.

For simplicity of calculation, take Mr. Macdonald's assumption of a segment 21 in. high and 936 sq.in. in area, giving an average width of 44.5 in. By the ordinary formula this ½-in. plate would carry 37 lb. per sq.in. without staying. This, subtracted from the working pressure of 125 lb., leaves 88 lb. to be carried by stays. Taking these at 55,000 lb. per sq.in., with a factor of safety of 8, there would be required 12 sq.in. of stay section. Assume that through stays 18 ft. long are used.

Now, we can consider the plate as a beam fixed at the ends and uniformly loaded. The deflection of such a plate is found by the formula,

$$s = \frac{W_p l^3}{32Ebd^3}$$

in which

s = Deflection at center, in inches;
W_p = Total load on plate, in pounds;
l = Length of span, in inches;
E = Modulus of elasticity;
b = Width of plate, in inches;
d = Thickness of plate, in inches.

The stay rod is in direct tension, so that the elongation is found by the formula,

$$s = \frac{W_s L}{EA}$$

in which

s = Elongation, in inches;
W_s = Total load on stay rod, in pounds;
L = Length of stay rod, in inches;
E = Modulus of elasticity;
A = Area of section of stay rod, in square inches.

The total load is $936 \times 125 = 117{,}000$ lb., which is equal to $W_p + W_s$, so that $W_s = 117{,}000 - W_p$. Since the elongation of the stay and the deflection of the plate are the same, it follows that

$$\frac{W_p l^3}{32Ebd^3} = \frac{(117{,}000 - W_p)L}{EA}$$

Substituting the known values for the various quantities, and letting $E = 28{,}000{,}000$,

$$\frac{W_p \times 21^3}{32 \times 28{,}000{,}000 \times 44.5 \times (\frac{1}{2})^3} = \frac{(117{,}000 - W_p) \times 216}{28{,}000{,}000 \times 12}$$

from which $W_p = 30{,}000$ lb., approximately. This is equivalent to $30{,}000 \div 936 = 32$ lb. per square inch of segment, which corresponds fairly closely to the 37 lb. calculated for.

If the stays were diagonal and, say, 4 ft. long, the value of W_p would be only about 8 lb. per sq.in., and Mr. Macdonald's objection is justified. This is still more the case in a firebox, where the stays are much shorter; for in general the stiff, unyielding member carries the stress for the flexible, yielding one.

The foregoing figures, of course, are only approximate, as it is very difficult to derive an accurate formula for the deflection of an irregularly shaped plate fixed at its edges; but they are, if anything, on the safe side in assuming the deflection of the plate too large and therefore the load carried by it too small.

Many other problems about which there has been almost endless discussion come in this class. The stress in cylinder-head studs is probably the most common one. It is difficult to make a man see, without the analogy of two springs—a heavy, stiff one barely started in compression corresponding to the cylinder head, and a lighter one already extended corresponding to the stud—that the stress in the stud may be only slightly increased by turning steam into the cylinder. Of course this is influenced by the kind and thickness of gasket used, and it is only when all such information is available that a definite solution can be obtained.

Newton Highlands, Mass. H. D. FISHER.

INQUIRIES OF GENERAL INTEREST

Number of Poles of A.-C. Motor—In a three-phase 60-cycle 2300-volt 20-hp. motor that runs at 450 r.p.m., how many poles should there be? J. D. M.

In an alternating-current motor, speed depends only on the frequency and number of poles. In revolutions per minute it is equal to frequency divided by number of poles multiplied by 120, hence

$$Poles = \frac{frequency \times 120}{r.p.m.}$$

and for 60 cycles and 450 r.p.m.

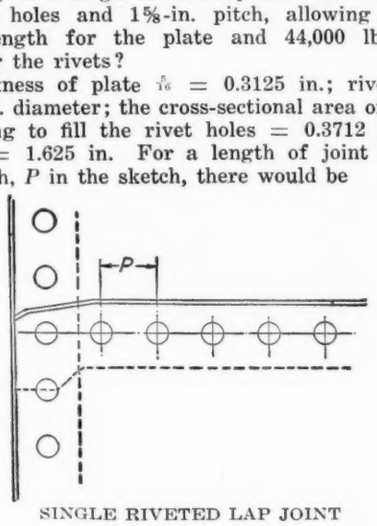
$$Poles = \frac{60 \times 120}{450} = 16$$

Bursting and Collapsing Pressure of Cylindrical Shells—Why is greater pressure required to burst a cylindrical shell from internal pressure than to collapse it from external pressure? J. J. B.

When a cylindrical shell is subjected to internal pressure, the circular form is improved; but where a cylindrical shell is subjected to external pressure, the slightest deviation from true cylindrical form is increased by the pressure, and failure occurs from buckling and bending of the material, followed by collapse of the shell long before the compressive strength of the material in true cylindrical form is reached. On this account theoretical formulas for the stresses in cylindrical shells subjected to external pressure are of little value.

Efficiency of Single-Riveted Lap Joint—What would be the efficiency of a single-riveted lap seam with ⅝-in. plate, ⅞-in. rivet holes and 1⅝-in. pitch, allowing 55,000 lb. tensile strength for the plate and 44,000 lb. shearing strength for the rivets? C. S.

The thickness of plate ⅝ = 0.3125 in.; rivet holes ⅞ = 0.6875 in. diameter; the cross-sectional area of the rivets after driving to fill the rivet holes = 0.3712 sq.in.; and pitch 1⅝ = 1.625 in. For a length of joint equal to a unit of pitch, P in the sketch, there would be



SINGLE RIVETED LAP JOINT

(A) Strength of solid plate,

$$1.625 \times 0.3125 \times 55{,}000 = 27{,}930 \text{ lb.}$$

The efficiency of the joint would depend on the following considerations:

(B) Strength of plate between rivet holes,

$$(1.625 - 0.6875)\,0.3125 \times 55{,}000 = 16{,}113 \text{ lb.}$$

(C) Shearing strength of one rivet in single shear,

$$1 \times 44{,}000 \times 0.3712 = 16{,}332 \text{ lb.}$$

(D) Allowing the crushing strength of the plate material to be 95,000 lb. per sq.in., the crushing strength of plate in front of one rivet.

$$0.6875 \times 0.3125 \times 95{,}000 = 20{,}410 \text{ lb.}$$

As the least strength would be obtained from (B) the efficiency of the joint would be

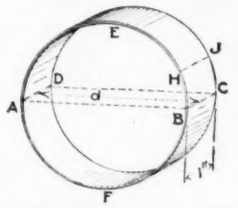
$$\frac{(B)}{(A)} = \frac{16{,}113}{27{,}930} = 57.6 \textit{ per cent}$$

Minimum Thicknesses for H. R. T. Boiler Shells and Heads—What is the least thickness of steel shell plates and tube sheets used for horizontal return-tubular boilers? F. M.

The minimum thicknesses of steel shell plates, used in good practice for horizontal return-tubular boilers of various diameters, are as follows: For shells 36 in. diameter or under, ¼ in.; over 36 in. to 54 in. inclusive, ⅜ in.; over 54 in. to 72 in. inclusive, ⅜ in.; and over 72 in., ½ in. The minimum thicknesses of tube sheets are: For 42 in. diameter or under, ⅜ in.; over 42 in. to 54 in. inclusive, ⅞ in.; over 54 in. To 72 in., inclusive, ½ in., over 72 in., ⅝ in.

Formula for Longitudinal Joint of Boiler Shell—How is the formula derived for figuring the working pressure of a cylindrical boiler shell with reference to the strength of a longitudinal joint and why is the radius used in place of the diameter? R. E.

In construction of a formula for determining the working pressure, it is convenient to consider that a portion of the shell 1 in. long consists of a hoop 1 in. wide, as shown in the sketch. Then the total internal pressure tending to pull apart one semicircular half $AEBCD$ from the other,



ILLUSTRATING HOOP STRESS

$AFBCD$, would be equal to the diameter in inches × 1 × the pressure per square inch or d in. × the pressure per square inch. Each side would be called upon to resist one-half of the total pressure tending to pull apart the hoop along the lines AD and BC, and therefore the "hoop stress," or girthwise pull, at any single cross-section, as along JH, would be ½ diameter in inches × 1 × pressure per square inch or, which is the same thing, radius × pressure per square inch, commonly written $R \times P$. The number of pounds of resistance offered by the hoop at any single cross-section would be its cross-sectional area in square inches × the tensile strength of the material in pounds per square inch, and if t = the thickness, in inches, and $T.S.$ = the tensile strength, pounds per square inch, then the hoop 1 in. wide would be capable of resisting at any single cross-section a pull of $(1 \times t) \times T.S.$, or $t \times T.S.$ pounds, and as the strength must be equal to the stress created by the internal pressure,

$$t \times T.S. = R \times P, \textit{ or } P = \frac{t \times T.S.}{R}$$

If $F.S.$ = the factor of safety that is allowed, then the pressure to be resisted must be regarded as $F.S. \times P$, and if E is the efficiency of the joint the strength will be $\frac{t \times T.S.}{R} \times E$, and it becomes necessary to have

$$F.S. \times P = \frac{t \times T.S.}{R} \times E, \textbf{ or}$$

$$P = \frac{t \times T.S. \times E}{R \times F.S.}$$

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications.—Editor.]

N. A. S. E. Convention at Cincinnati

PLANS are well under way for the thirty-sixth annual convention of the National Association of Stationary Engineers to be held at Cincinnati, Ohio, during the week of Sept. 9. Convention headquarters will be at the Hotel Sinton and the convention sessions and exhibits will be held in Music Hall. An excellent program has been prepared. Routine business will be conducted with dispatch. Reports of committees and national officers will be given in digest and as much time as possible reserved for papers of particular interest to the engineer and for welfare topics such as the "Questionnaire" and "Capitalizing Experience in the Power Plant." The papers, dealing with the "Commercial Values of Exhaust Steam in the Isolated Power Plant," "Practical Conservation of Coal in the Power Plant," "The Use of Fuel Oil in Steam Boiler Practice" and "Electric Illumination," are being prepared especially for the engineer by men well versed in the subjects covered. The four topics given are timely and are the very subjects to which all engineers should be giving their attention. If present plans carry through, Dr. Garfield will be heard at the convention. There is no body of men whom he could address to better advantage and it is the earnest desire of the committee that he shall be one of the speakers.

HOTEL SINTON, CONVENTION HEADQUARTERS

CONVENTION COMMITTEE, NATIONAL ASSOCIATION OF STATIONARY ENGINEERS

Standing, left to right: William Mittendorf, George H. Coulthard, Theodore Nielander, Joseph Van Hoene. Seated: R. W. Parry, chairman, Edward Laudeman, Louis T. Kaiser

The national convention committee consists of R. W. Parry, chairman; Edward Laudeman, Louis Kaiser, Theodore Nielander, William Mittendorf, Joseph Van Hoene and George Coulthard. On the advisory committee are John A. Kerley, chairman; Mayor Galvin; Thomas Quinlan, of the Chamber of Commerce; Charles E. McFarlan, of the Wm. Powell Co.; and Lane Thompson, of the Lunkenheimer Co. The convention program follows:

Monday, Sept. 9, official registration of officers, delegates and visitors at Music Hall. During the day the reception committee will meet arriving delegates and visitors and escort them to headquarters. At 8 p.m. the mechanical exposition in Music Hall will be formally opened, with R. W. Parry, chairman of the convention committee, presiding. Paul T. Payne, president of the National Exhibitors' Association, will deliver the address of welcome. The response by John A. Wickert, president of the National Association of Stationary Engineers, will be followed by a band concert.

Tuesday, Sept. 10, at 9 a.m., officers, delegates and visitors will assemble at the Sinton Hotel and parade to Music Hall. Opening exercises of the convention will begin at 9:30, with R. W. Parry in the chair. Invocation by Dr. Webster Stockstill, pastor of the Methodist Episcopal church in Norwood. Address of welcome by the Hon. James M. Cox, governor of Ohio. Response by John A. Wickert, national president. Welcome to Cincinnati by Mayor John A. Galvin. Response by Roderick MacKay, national vice president. Address by Luke Smith, president of the Cincinnati Chamber of Commerce. Response by John A. Kerley, national past president. Address by S. B. Balmfirth, of Toronto, representing the Canadian Association of Stationary Engineers. Dedication of the N. A. S. E. service flag. Official opening of the convention and appointment of convention committees by National President Wickert. After adjournment the official group picture will be taken.

At 1:30 p.m. will begin the first business session of the convention. The various committees and national officers will report briefly. At 3 p.m. an illustrated lecture on "Electric Illumination," by Geo. W. Stickney, of the Illuminating Engineering Society. At 4 p.m. an address on the "Value, Importance and Benefits of the Life and Accident Insurance Departments of the N. A. S. E.," by Judson Pratt.

Wednesday, Sept. 11, at 9 a.m., final report of the Credential Committee, official roll call and introduction of officers and delegates, report of board of arbitration, report of

board of trustees of protection fund and report of board of trustees of *National Engineer*. At 11 a.m. an illustrated lecture on "Commercial Values of Exhaust Steam in the Isolated Power Plant," by Frederick C. Ruck, chief engineer of the Public Museum, Milwaukee, Wis. Wednesday afternoon will be given over to the annual field day and entertainment.

Thursday, Sept. 12, at 9 a.m., business session. At 10.30 a.m. discussion by delegates on "Being an efficient officer—what it means to the officers and to the association." At 11:15 a.m. official visit to the convention by the Ladies'

MUSIC HALL, WHERE THE MEETINGS WILL BE HELD

National Auxiliary. Memorial services. At 1:30 p.m. illustrated lecture on "The Use of Fuel Oil in Steam Boiler Practice," by Roderick MacKay, national vice president. Following these papers will be a discussion by the delegates of "Capitalizing Experience in the Power Plant." At 8 p.m. entertainment at Music Hall under the auspices of the National Exhibitors' Association.

Friday, Sept. 13, at 9 a.m. business session, election of officers and selection of next place of meeting. At 8 p.m. public installation of officers and the annual ball at the Hotel Sinton.

Attention is called to the exhibit of the National Educational Committee and the National Power Plant Cost Committee in booths Nos. 101 and 102, exhibit hall, where general information on the educational work will be available.

Previous to the national convention, on Sept. 8 and 9 the Ohio State Association will hold its annual convention in Memorial Hall, headquarters being at the Hotel Sinton.

American Society for Testing Materials Report on Lubricants

The following is from the report of Committee D-2 on Lubricants to the American Society for Testing Materials at its recent meeting at Atlantic City, N. J.

The committee feels that the need of an evaporation test for lubricating oils has not been demonstrated. In view of the results obtained, as shown in the report of the sub-committee on Evaporation Tests indicating that concordant results cannot be obtained unless the conditions as to air bath, method of heating the same, size and shape and materials of dishes used, method of placing dishes in the air bath and location of the thermometer bulbs, are identical, no further work on evaporation will be done by the committee until the need of such a test is shown.

The committee respectfully recommends to the society the adoption as standard the following tests included in the Tentative Tests for Lubricants (D 47-17 T) presented last year and published in the *Proceedings*:[1]

Specific Gravity, revised to read as follows by the addition of the italicized words:

Specific gravity may be determined by hydrometer, Westphal balance, or pyknometer, providing these instruments are verified. The observation shall be taken with the sample at 15.56 deg. C. compared with water of the same temperature. *Correction for the buoyant effect of the "atmosphere" shall be made when necessary.*

Cloud and Pour Test for Petroleum Oils except Steam Cylinder and Black Oils;

Cold Test for Steam Cylinder and Black Oils;

Free Acid;

Carbon Residue.

The committee further recommends that "standard temperatures for viscosities" contained in the tentative tests submitted last year be withdrawn. In explanation of this recommendation the committee believes that while eventually the adoption of these standard temperatures will be desirable, such adoption is not feasible at the present time. The use of the Fahrenheit temperatures 70 deg., 100 deg. 130 deg. and 210 deg. represents the common American practice. The committee's temperatures were approximate Centigrade temperatures approaching these as near as would be possible in round figures. At the present time, however, due to war conditions, not only has the use of the Fahrenheit temperatures greatly increased in this country, but these temperatures have also been adopted abroad—for instance, by the British government—and it is the feeling of the committee that an attempt to change the standard temperatures at the present time would result in confusion in the specifications for oils for the various governments and might tend seriously to delay matters looking toward the successful prosecution of the war. The committee anticipates that at a later date it will again present these temperatures for adoption as standard by the society.

Pittsburgh To Get Water Power

Because of the great amount of war work done in the Pittsburgh district, there is, or was, apprehension as to the district's ability to take on the increasing industrial load, owing chiefly to lack of power. It is encouraging, therefore, to hear that the Cheat River plant will be rushed to completion.

The plant near Cheat Haven, Penn., at the Pennsylvania-West Virginia State line, has an 86-ft. head of water, and was built to accommodate four generator units of 12,500 hp. The power to be developed in this plant is one-third as much as the capacity of the Brunots Island plant, and is equivalent to all the power generated in all of the four power-plants operating the Pittsburgh traction system before the Brunots Island plant was built.

The contract for the Cheat River plant, which amounted to $4,000,000, was placed with the T. A. Gillespie Co. and when work was stopped the Gillespie company took a lien on the property. Ownership at present is in the West Penn Power Co. The power company has high-tension lines for the transmission of the current built up to the plant, and the distribution of the power would be immediate after the plant was completed and put into operation.

The dam has a total length of 1000 ft., the spillway section being 624 ft. This dam is one of a series of six that were planned by the Kuhn interests on the Cheat River and its tributaries. The power house is approximately 250 ft. long and 100 ft. wide and is erected as a portion of the dam structure.

The length of the reservoir formed by this dam is about 13 miles, and its available storage capacity 40,000 acre-feet. A branch from the Baltimore & Ohio R. R. has been built from Cheat Haven, Penn., to the plant.

Are you putting the heating system in order? This is the time to do so.

[1] *Proceedings*, Am. Soc. Test. Mats., vol. xvii, part I, p. 767, 1917.

Possibilities of Peat as Fuel

In view of the danger of another coal shortage the Director of the United States Geological Survey calls attention to the practicability of using peat as fuel in some localities and offers some suggestions as to the preparation, storage, value, and use of peat. The time is now ripe to prepare and store peat fuel. Vast deposits of peat that could be converted into fuel are found throughout Minnesota, Wisconsin, Michigan, New York, and the New England States, and in the northern parts of Iowa, Illinois, Indiana, Ohio, Pennsylvania, and New Jersey and also on the Atlantic Coastal Plain from New Jersey to southern Florida and westward along the Gulf coast to the Mexican boundary. The preparation and storage in farming communities and villages of peat fuel taken from these deposits by the owners of small bogs and by citizens' associations for distribution among their members would not only increase the local fuel supply and in many localities prevent a recurrence of the suffering caused by our recent coal shortage, but would release railroad cars that will be vitally needed for other purposes.

Fuel Value of Peat

Peat, or muck, as this mineral is frequently called, consists of partly decayed plant remains that contain enough carbon to ignite and burn freely when dry. In texture it ranges from a fibrous imperfectly decayed kind through progressive degrees of decomposition to a thoroughly disintegrated type, and varies correspondingly in color from light yellow to jet black Peat in an undrained bog contains about 90 per cent. of water, which must be reduced to 30 per cent. before it can be used for fuel by thoroughly drying in the open air or in a heated chamber. Artificial drying, however, requires so much heat in comparison with that obtainable from the fuel prepared by this process, that so far as the United States Geological Survey is aware, it has not proved commercially feasible. The value of a given deposit of peat as a source of fuel is dependent on many factors, most important of which are degree of decomposition, heating value and ash content. Coarse-textured fibrous peat makes fuel that is inferior to the black, compact, thoroughly decomposed kind, unless that kind contains a very large proportion of ash. The maximum quantity of ash that is usually considered allowable in peat for commercial use has been placed between 20 and 25 per cent., but if the content of ash exceeds 20 per cent. of the total weight of the dry peat it is scarcely worth the labor of production, even for home use. The heating value and ash content may be determined by a simple practical test. A typical sample should be taken from the bog, thoroughly macerated, dried, and weighed. If, when burned in an ordinary heating stove, the heat generated is almost equal to that produced by bituminous coal, and after complete combustion the weight of the ash does not exceed 20 per cent. of the weight of the dry peat before burning, its usefulness as domestic fuel is established.

Methods of Preparation

The season for drying peat begins about Apr. 15, or as soon as the frost is out of the ground, and ends in September except in the southern region, where it is somewhat longer. Present industrial conditions prohibit the manufacture of large-capacity peat-fuel machines for operation this year, as such machinery, on account of the small demand in this country, has to be specially designed and constructed. It seems, therefore, that peat intended for use next winter will have to be prepared either by hand or by existing machinery that can be readily converted to use for producing peat fuel.

The hand-cut process of preparing peat, which is widely used in Ireland, seems most practicable for the owners of small deposits in the United States. Before this method can be used the deposit must be thoroughly drained and cleared, and the turf removed from its surface. Most bogs of the built-up type—that is, those which were formed by the deposition of the remains of plants that grow near the ground-water level—can be drained to the bottom by a simple system of surface ditches. Lake bogs, in which the deposit has accumulated below a permanent water level can not generally be drained far below the surface of the peat without incurring great expense, and are therefore not so well adapted to hand digging as built-up beds. However, many lake bogs in the northern peat region, where most of the marshes in which this mineral has accumulated were formed during the Wisconsin or last glacial stage, may be sufficiently drained for peat recovery by means of a short drainage canal connecting the edge of the basin at the lowest level with an adjacent stream.

After the surface of the bog has been cleared, the peat is dug in brick form with a special tool called a slane. This instrument, which can be made by a blacksmith, is a narrow spade with a sharp steel lug welded on one side at right angles to the edge of the blade. The blocks of peat range from 8 to 10 in. in length, from 4 to 7 in. in width, and from 3 to 6 in. in thickness, their dimensions depending on the size of the slane. As they are dug, they should be removed to the drying grounds and stood on end or placed on covered racks. At the end of about four weeks, during which they should be frequently turned until their moisture content is reduced to about 30 per cent., the blocks are usually ready for storage. As cut peat absorbs water rapidly, great care should always be taken to protect the dry blocks from rainfall. Peat fuel prepared in this way is bulky, easily crushed and burns rapidly with considerable waste. In heating value it is superior to wood, but it is unfitted for commercial use.

Peat Fuel Production by Machine

To produce peat fuel of better quality and in larger quantity than is possible by hand, the machine process should be used. The machinery for a small plant is simple and could be quickly obtained and easily operated. It consists essentially of an excavator and a macerator. The steam shovel could be used for digging peat from drained deposits; the dipper dredge is well adapted to removing this mineral from undrained reposits. The purpose of the macerator is to grind the constituents of the wet peat into a homogeneous pasty mass, which may be shaped into compact blocks. In principle and form the latest types of such machines are similar to the pug mill or grinding machine for plastic clay. Many of the experimental plants in the United States have used brickmakers' plug mills, with very slight changes, to grind peat, and they have proved to be well suited for the purpose. After being thoroughly macerated, the peat should be shaped into blocks as it issues from the machine or spread in a layer, from 8 to 12 in. thick, on the drying grounds and the bricks marked off by hand as the spreading proceeds. When partly dry they are loosely stacked or placed on drying racks and thereafter handled in the same manner as cut peat. Machine peat that is allowed to dry slowly contracts into a dense mass covered by a gelatinous skinlike substance called hydrocellulose. After the moisture has been reduced to about 25 per cent., this coating renders it impervious to water, even when immersed. In heating value a ton of machine peat is equal to about 1.3 tons of wood, seven-tenths of a ton of good bituminous coal, or half a ton of anthracite. Despite the disadvantages of cut peat, air-dried machine peat is well adapted for domestic use. It is clean to handle and burns freely, yielding an intense heat and producing no soot or other objectionable deposit. For open grates this fuel is nearly ideal, and it is said that peat may be burned in the same stoves as coal and wood. However, the best results could probably be obtained by burning it in a stove with relatively small grate openings and a restricted draft.

A full description of the methods of preparing peat fuel is given in Bulletin 16 of the Bureau of Mines, Department of the Interior, Washington, D. C., from which copies of it may be obtained.

According to the London *Electrical Review*, the Paris *Auto* announces the discovery of a new combustible which contains neither gasoline, coal gas nor alcohol, experiments with which have given very favorable results. The new fuel is secured by the distillation of the heavy oils, obtained from the chemical distillation of coal, the process being carried out in such a way that all the byproducts from its manufacture become available for the preparation of nitro-explosive. It is claimed for the new fuel that it does not foul the cylinders or leave a residue of carbon, and the consumption is stated to be less than that of gasoline.

Graded Licenses in Ontario

For ten years engineers in the province of Ontario have been obliged to have licenses, but as the license has been issued in the same form to everybody affected by the law which requires it, from the most irresponsible to the chiefs of large enterprises, and as little more than successful service was required for its attainment, its possession has amounted to little as a certification of engineering acquirement.

For a number of years the engineers of the province have been agitating for a graded license law, and are gratified by the adoption by the commission of the following resolutions:

Fourth-Class Certificate: This certificate shall be known as a Fireman's Certificate, and shall be optional on the part of the applicant. This class will include firemen, night watchmen and other assistants to the engineer. The examination is to be oral, the questions to be based on the safe handling of steam boilers and feeding apparatus.

Present or Compulsory Certificate: The certificate, which has been known as the "Stationary Engineer's Certificate" since the inauguration of this board in 1908, shall, after the grading of certificates, retain its present standard, and it shall be compulsory for all engineers operating stationary steam plants of fifty horsepower or over, carrying over twenty-pound steam pressure, to hold this certificate, irrespective of the Fireman's Certificate which they must obtain before trying this examination, unless they can produce a certificate of equivalent value issued by another Government board. The examination is of a purely practical nature.

Second-Class Certificate: This certificate shall be optional and recognized as one grade above the present engineer's certificate. Examinations are to be written and the questions are to be of a practical and technical nature combined. An applicant for this certificate must be a holder of the present Stationary Engineer's Certificate issued by this board, or a certificate of equivalent value issued by another Government board.

The holders of the present certificates may be granted Second-Class Certificates provided their experience, standing, character, etc., warrant same; length of experience to be decided on at a later date by the board.

First-Class Certificate: This certificate shall be optional and one grade above the Second-Class Certificate. An applicant for this certificate must hold a Second-Class Certificate issued by this board, or its equivalent issued by some other Government board, together with ten years' continuous experience in the handling of steam plants. This certificate can be obtained by examination only, such examination to be of a highly technical and practical nature.

General Information: On and after Jan. 1, 1919, this board will be open to receive applications for the four grades of certificates mentioned, and forms for same can be obtained by making application to the office of the Stationary Engineers' Board, 15 Queen's Park.

On and after Jan. 1, 1920, applicants for any grade must first obtain the lowest grade and take all examinations up to the grade they may desire, except they can produce certificates of equal standard issued by another Government board.

The present or Compulsory Certificate *only* will be issued to applicants for a Provisional Certificate.

It is the intention of the board to have all applicants' forms which have been returned to the board classified into their respective grades by Jan. 1, 1920.

When Thieves Fall Out

Complaint was filed with the Federal Trade Commission by one of the oil companies of Shreveport, La., alleging unfair practices on the part of one of its competitors. An investigation was made and the complaint, together with the result of the commission's investigation, was referred to the United States Fuel Administration. A hearing was held in Washington by the Oil Division of the Fuel Administration on July 11, 1918, resulting in instructions being issued on July 19 by the Fuel Administration directed to all oil companies operating in Shreveport and vicinity as follows:

Pending the issuance of a general order you are directed as follows: Make no allowance to retailers on gasoline or kerosene exceeding one cent per gallon. Make no drayage allowance to consignees on drum or barrel shipments. No permanent equipment shall be given or loaned, and sale or rental must be based on a fair value. Give no premiums, secret fees or rebates. Coupon books (if sold) not more than 2 per cent. discount for cash. Neither buy nor rent premises nor equipment from existing retailers. Furnish retailers no employees. Pay retailers no salaries or commissions.

It is the intention of the Fuel Administration to issue, after full investigation, a general order regulating the trade practices of oil-marketing companies throughout the United States. The oil industry will be asked to give prompt consideration to all existing trade practices and to advise the Oil Division of the Fuel Administration in regard thereto. This may be done either direct or through the National Petroleum War Service Committee or its subcommittees throughout the country. It is hoped that by this means the order when issued will be as fair and as far-reaching as possible, so as to bring about a correction of whatever discriminations and abuses may now exist.

Aged Retired Miners Return to Work in the Coal Fields

Enthusiasm for increased production in the coal fields is growing rapidly, and in practically every district the mine workers, who, as President Wilson says, are "enlisted in the great service army," are striving to break their own production records week by week.

A striking evidence that the mine worker has become impressed with the vital importance of the work intrusted to him comes from the mines of the Mercer Iron and Coal Co. at Stoneboro, Penn. These miners are the oldest in that section of the country and have for years produced a large quantity of high-grade coal. Their production is in the neighborhood of 500,000 tons a year.

There were in that section about one hundred and fifty miners who had been in the service of the company years ago and, on account of age, had retired from active mine work. Realizing the country's need of coal at this time, they came forward voluntarily and agreed once more to take up the pick and shovel. Many of these men had been able to set aside sums sufficient to maintain them in comfort during their declining years, but feeling they were not fit for military service, chose this way of emphasizing their loyalty to the country.

They were given employment in a new opening on the mine, an opening not yet connected by railroad, but while waiting for a siding to be completed they have mined over 4000 tons of coal, which is piled up waiting to be hauled away.

It is this spirit throughout the coal fields which is responsible for the constant breaking of coal-production records.

A permit will have to be obtained from the Missouri State Fuel Administration hereafter before any new steam-generating plant can be built for manufacturing purposes or before an old power plant can be equipped with additional machinery or parts. This is the requirement made in an order issued by Fuel Administrator Crossley on July 16, effective at once. Manufacturers violating the order may be penalized by the administration through the withholding of fuel. The regulation follows:

Every manufacturer and prospective purchaser of all sorts of steam-generating equipment to be used for the production of all sorts of commodities is required to file with the fuel administration a description of the equipment and the estimated daily fuel consumption, anthracite or bituminous.

This administration will then take under consideration the effect of proposed installation for the prosecution of the war. At the same time the probable efficiency of such plants will be judged by the state advisory engineer before construction is permitted to proceed.

Failure to comply with this order may result in the withholding of fuel by this administration. Enforcement will be placed in the hands of J. A. Whitlow, administration engineer of the State Fuel Administration.

The purpose of this order, it is announced by the administration, is to secure such installations as will make the most economical use of coal.

Discrepancy in Water Power Reports

A wide discrepancy between the reports on the water-power shortage filed by Lester S. Ready, chief engineer of the gas and electric department of the California State Railroad Commission and the report on the available water supply on the system of the Great Western Power Co. filed with Power Director H. G. Butler has been charged by engineers and officials for various California power companies.

Mr. Ready, it is said, has based his calculations on the condition existing in 1912, which was the dryest year in the state. Taking these figures as his basis, he found that during the next six months the stream flow on the Great Western system would produce 130,000,000 kw.-hr., the storage water 55,000,000 kw.-hr. and in addition the company would have an output from its steam plants of 85,000,000 kw.-hr., or a total output of 270,000,000 kw.-hr. for the entire system.

The demand on the Great Western Power Co., last year, says the Ready report, was 254,000,000 kw.-hr., but from this total the load of 55,000,000 kw-hr. supplied the Pacific Gas and Electric Co. has been taken off and the load of 12,000,000 kw-hr. supplied to the United Railroads in San Francisco has been dropped. This brings the demand on the Great Western down to 187,500,000 kw.-hr. for the next six months. Adding 16 per cent. for the increased demand from industrial consumers that may be expected, says the Ready report, the total demand on the Great Western Co. would be only 216,000,000 kw.-hr. against an output during the most acute year on record of 270,000,000 kw.-hr. This would leave a surplus of at least 50,000,000 kw.hr. that could be supplied the Pacific Gas and Electric Co.

The engineers of the Great Western Power Co. contend, however, that all records for dry years have been broken this season. It has been intimated that should Mr. Ready's figures be correct the Great Western Power Co. would have a surplus of power that could be disposed of at much higher rates unless the power director should order it delivered to the Pacific Gas and Electric Co., which has not enough power for the needs of some essential Government industries.

The suggestion has also been made that in the event that a surplus for water does exist on the Great Western system, an effort may be made to use the water for irrigation of a large acreage planted to rice by some of the principal owners of the Great Western Power Co.

In view of the wide discrepancy between the reports of Mr. Ready and the engineers of the Great Western Co., Power Director Butler is known to be making a thorough investigation before recommending any action or ordering any curtailment. It is also pointed out that one of the steam generating power plants of the Sierra & San Francisco Power Co. in San Francisco is standing partly idle. Should it be put into operation at its full capacity of 10,000 kw., it would be able to absorb at least 25 per cent. of the shortage that might be created even if the figures of the Great Western Power Co. are found to be correct, say the company engineers.

Assuming that Mr. Ready's figures are correct and that the Great Western Co. is ordered to deliver this possible surplus to the Pacific Gas and Electric Co., an engineer of the latter concern stated that the Pacific company then would be able to carry its present load without cutting the supply of any of its customers.

A plan for the generation of electrical energy at mine-mouth plants in the anthracite field of Pennsylvania and the transmission of this energy by high-tension lines to industrial plants in that section and along the eastern seaboard was originated by the Pennsylvania State Fuel Administration to meet the growing demands of war industries for electric current and at the same time ease the fuel situation. The plan is said to have been approved by the President as well as by the heads of the departments supervising the war activities of the nation, including Secretaries McAdoo, Baker and Daniels and Charles M. Schwab, Edward N. Hurley and Bernard M. Baruch. To carry out the plan a bill will shortly be introduced in Congress to appropriate $200,000,000 for the work.

Fuel Situation in Turin Italy

The annual consumption of coal in the City of Turin is about 80,000 tons under normal conditions, at an average price of $7 per ton. War has affected the price of this commodity to an extraordinary extent. The problem of fuel has incited closer studies into the use of waste and by products, so that while this war has been destructive in one sense, it has proved constructive in another. It has developed efficiency in the industrial world through elimination of waste, be it either fuel or labor, and in many instances the output has increased, notwithstanding the decreased power available. The possibility of utilizing former waste products as fuel has been demonstrated in connection with such materials as the seed pulp remaining after the extraction of oils, also rice hulls, sawdust and other substances having a high cellulose content which can be mixed with a second body to form a satisfactory fuel. Wood refuse in Italy is about 300,000 tons per annum, not including sawdust, which is approximately 200,000 tons. Wood without bark has been found to give from 5 to 8 per cent. of ash, while branches and bark only give from 2.5 to 3 per cent. ash. Wood ash is considered most important as a fertilizer for the potash contained therein.

The utilization of sawdust as a fuel for heating is much in favor in northern Italy, where special types of stoves have been developed which require no attention once the fire has been lighted. This kind of heating is admirable for small apartments, offices and shops and has the added advantage of not only saving in storage space (which would otherwise be required for a supply of wood) but the cost of heating is reduced to a minimum. Waste products in general are now being utilized to a large extent, thus considerably increasing the production of oils, tar, acetic acid, and charcoal, products formerly imported into Italy.—*Commerce Reports.*

America Foremost in Mineral Productions

America is a country that produces over 40 per cent. of the world's coal and 66 per cent. of its petroleum, thus constituting a lead in fuel, which is of first importance. Its mines, furnaces and smelters yield 40 per cent. of the world's iron, 60 per cent. of the copper, and 32 per cent. of the lead and zinc, and it is easy to understand, therefore, why the country stands first as a manufacturing country. The growth of this mineral industry began in 1880, the value then being $367,000,000, while in 1916 it was $3,515,000,000, or nearly ten times as much. During this period the population has only doubled and yet the consumption of coal per head has increased from 1½ tons in 1880 to 6 tons in 1915, or an increase of 357 per cent. Similarly, the production of iron ore has increased 337 per cent., petroleum 391 per cent., copper 1200 per cent., cement 2087 per cent., lead 125 per cent., zinc 638 per cent., while gold and silver only increased about 22 per cent. In regard to agricultural products, the increase has only remained proportional to the increased population, with the exception of cotton and sugar, the former's increase being 130 per cent., and the latter's 394 per cent.—*From Indian Engineering, Calcutta, India.*

According to *Commerce Reports* electricity has come into extensive use in South Africa for light and power purposes, especially in the Transvaal. Apart from the power generated at the mines, 836,437,817 kw.-hr. was supplied during 1916 by the various stations of corporations and municipalities and by the public-supply companies in the Union. Of the total, 784,847,599 kw.-hr. was alternating current, of which 783,689,784 kw.-hr. was used for light and power, and 1,157,815 kw.-hr. was converted into direct current for tramways. In the mines and industries of the Transvaal, Cape Province, Orange Free State and Natal there are in use 782 direct-current generators having a total capacity of 65,039 kw., 240 alternating-current generators of an aggregate capacity of 255,697 kw., 4367 direct-current motors having a total capacity of 85,347 hp., and 7377 alternating-current motors totaling 462,848 hp. capacity.

New Publications

HEATING AND VENTILATION. By John R. Allen and J. H. Walker. Published by McGraw-Hill Book Co., Inc., 239 W. 39th St., New York. London, 6 and 8 Bouverie St., E. C. Cloth; 305 pages; 6 x 9 in.; 175 illustrations. Price, $3.

This book by well-known authorities is intended primarily as a textbook on heating and ventilation, for use in engineering and architectural schools. It is also believed that the development of working methods of design and the various charts and tables included make the book valuable for the practical engineer and architect. Although calculus has been employed in the development of certain expressions, such parts may be passed over without destroying the structure of the book. The subject matter has been divided into eighteen chapters as follows: Heat; Heat Losses from Buildings; Different Methods of Heating; Properties of Steam; Radiators; Steam Boilers; Steam-Heating Systems; Pipes, Fittings, Valves and Accessories; Steam Piping; Hot-Water Systems; Automatic Temperature Control; Air and Its Properties; Ventilation; Hot-Air Furnace Heating; Design of Fan Systems; Air Washers and Air Conditioning; Fan Systems for Various Types of Buildings; Central Heating.

At the close of many of the chapters problems are given, the solution of which involves the application of the principles laid down in the preceding pages. In the use or study of this book there is the comfortable feeling that it is not speculative and theoretical, but practical and authoritative.

CIRCULAR OF THE BUREAU OF STANDARDS No. 13. Eighth edition. Department of Commerce, Washington, D. C. Paper; 7 x 10 in.; 14 pages. Price, 5c.

This circular dealing with standard specifications for incandescent electric lamps, gives the general specifications under which lamps are purchased for the Government, including mechanical and physical characteristics of the lamps, the method of initial inspection and tests and of tests to determine life and candlepower maintenance.

The second part of the circular gives schedules of detailed requirements of efficiency rating and life performance of the various sizes and classes of lamps covered by the specifications. These include tungsten (or Mazda) and carbon lamps of the range from 110 to 125 volts and from 220 to 250 volts.

The most important changes introduced in this edition are that specifications for gas-filled tungsten (or Mazda) lamps are introduced, and that on vacuum tungsten lamps some readjustment of efficiency ratings has been made to meet changed conditions in manufacture resulting from the war. Since the gas-filled lamps have not heretofore been covered by these specifications and manufacturing conditions are at present somewhat uncertain, the special provision is made that such lamps shall not be rejected if the test life is not less than 1000 hours when the lamps are tested to 75 per cent of the initial candle power, although the average life is expected to be 1000 hours when tested to 80 per cent of the initial candlepower.

BUREAU OF MINES BULLETINS

The Department of the Interior, Bureau of Mines, announces the following new publications:

Bulletin 103. Mining and concentration of carnotite ores, by K. L. Kithil and J. A. Davis. 1917. 89 pages, 14 plates, 5 figures.

Bulletin 140. Occupational hazards at blast-furnace plants and accident prevention, based on records of accidents at blast furnaces in Pennsylvania in 1915, by F. H. Willcox, 1917. 153 pages, 16 plates.

Bulletin 149. Bibliography of petroleum and allied substances, 1915, by E. H. Burroughs. 1918. 147 pages.

Bulletin 155. Oil-storage tanks and reservoirs, with a brief discussion of losses of oil in storage and methods of prevention, by C. P. Bowie. 1918. 76 pages, 21 plates, 4 figures.

Technical Paper 170. The diffusion of oxygen through stored coal, by S. H. Katz. 1917. 48 pages, 1 plate, 27 figures.

Technical Paper 172. Effects of moisture on the spontaneous heating of stored coal, by S. H. Katz and H. C. Porter. 1917. 25 pages, 1 plate, 8 figures.

Technical Paper 202. Metal-mine accidents in the United States during the calendar year 1917, compiled by A. H. Fay. 1918. 91 pages.

Note—Only a limited supply of these publications is available for free distribution and applicants are asked to coöperate in insuring an equitable distribution by selecting publications that are of especial interest. Requests for all papers can not be granted. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

BULLETIN ON ANALYSES OF COAL

At this time, when fuel engineers and manufacturers are deeply interested in the conservation of fuel in order that those industries essential to winning the war may not be handicapped, they will welcome a publication just issued by the Bureau of Mines, giving thousands of analyses of coals from many hundred mines in the United States, for these analyses enable the users of coal to realize the amount of heat they are buying. Bulletin 123, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1913 to 1916," is a continuation of the sampling and analyzing of the coals of the country begun by the Federal Government in 1904. It is the third of the series, Bulletin 22, "Analyses of Coals in the United States," which can now only be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 85 cents, being the first. The second bulletin of the series, Bulletin 85, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1911 to 1913," is still available for distribution by the Bureau of Mines. The present bulletin presents analyses and descriptions of samples collected during the fiscal years 1913 to 1916. Copies of Bulletin 123 may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C., as long as the present edition remains.

Personals

C. D. Miller has been appointed manager of the Buffalo branch office of the Burke Electric Co., of Erie, Penn.

Miscellaneous News

Elimination of Superfluous Lighting and power plants is to be brought about in Illinois to reduce coal consumption. It is believed that millions of tons can be saved by doing away with needless duplication. The fuel administration declares that coal will be withheld entirely from stubborn concerns. After survey of a similar plan in England the fuel administration has appointed a committee on power unification and utilization for Illinois.

At Thirty-one Posts, Camps, cantonments and stations in the territory south of Washington and west of Pittsburgh approximately 200,000 tons of anthracite were called for to cover requirements for the fiscal year 1919. As a result of investigations made by the Fuel and Forage Division of the Quartermaster Corps, bituminous coal and coke have been substituted for anthracite and a saving has been effected of approximately $300,000 in the cost of coal and approximately $200,000 in the cost of transportation, or a total saving of about $500,000. In addition to the saving in cost, as indicated, there will be a saving in transportation amounting to about 33,000,000 ton-miles, which will make available for other purposes this amount of railroad transportation.

Business Items

The John F. Robertson Co. of Pittsburgh, Penn., has appointed James H. Pearson its New York City representative at 81 White St. The same company has appointed F. J. Murray manager of its Chicago Branch, at 601 Pontiac Bldg.

The Lagonda Manufacturing Co., of Springfield, Ohio, announces that its Syracuse (N. Y.) office, of which T. X. Lieb is in charge, has been moved from 2400 South Salina St. to 219 Union Bank Building. The Cincinnati branch of the company has also recently moved from the First National Bank Building to 2607 Union Central Building. Frank Walmsley is in charge of this branch.

Trade Catalogs

Vertical Triplex Power Pumps. Worthington Pump and Machinery Corp., New York. Deane Bulletin D-702. Pages 55, 6 x 9 in.; illustrating and describing vertical triplex power pumps, single- and double-acting.

New Construction

PROPOSED WORK

Conn., Waterbury—The American Brass Co., Grand and Meadow Sts., will soon receive bids for a 2-story, 90 x 150 ft. reincon., steel and brick power plant addition on Benedict and Burnam Branch, and will install 800 hp. equipment, boilers, turbines and generators. E. Coe, c/o American Brass Co., Arch. Estimated cost, $90,000.

N. Y., Bath—J. S. Maxwell, Pres. Board of Managers, New York State Soldiers' and Sailors' Home, is receiving bids until Aug. 21, for the installation of a new heating system in present barracks.

N. Y., Brooklyn—The Board of Education will soon receive bids for the installation of a heating system in the new 5-story school to be erected on Baltic and Henry Sts. C. B. J. Snyder, 59th St. and Park Ave., New York City, Arch. Noted July 30.

N. Y., Brooklyn—J. Kestenbaum, 229 6th Ave., will install a steam heating system and boilers in connection with the proposed 1-story garage. Cohn Bros., 361 Stone Ave., Archs.

N. Y., Buffalo—The National Lamp Works and the General Electric Co., 1004 Illuminating Bldg., Cleveland, Ohio, plans to install an 800 hp. power plant in connection with the proposed 3-story factory to be erected here, at 1495 Fillmore Ave.

N. Y., Flushing—The Bureau of Street Cleaning. J. Fetherston, Comr., Fulton St., Jamaica, plans to install a 400 hp. closed type, full floating head steam water heater with two 5¼ x 3⅛ x 5 in. outside entacked duplex steam pumps, in connection with the proposed garbage distruction plant to be erected in Flushing.

N. Y., Long Island City—A. Cohen, 212 5th Ave., New York City, plans to install a steam heating system and boilers in the proposed 3-story mill to be erected here on William St. and Freemen Ave. Dwight & Seabury, Pawtucket, R. I., Archs.

N. Y., Long Island City—The National Carbon Co., Thompson St., Brooklyn, plans to extend its heating system in connection with the proposed 1-story addition. M. N. Franke, 25 East 26th St., New York City, Arch.

N. Y., New York—J. Massimimo, 11 West 117th St., will soon receive bids for boilers to be installed in the proposed 1-story garage to be erected on Grant Ave and 162nd St. Starrett & Van Vleck, 8 West 40th St., Archs.

N. Y., New York (Borough of Bronx)—J. O'Leary, 99 East 157th St., plans to install a steam heating system and boilers in connection with the proposed 1-story garage to be erected on Eagle Ave. and 158th St. Dunnigan & Crumey, 3rd Ave. and 149th St., Archs.

N. Y., Syracuse—The Semet Solvay Co., Milton Ave., is receiving bids for rebuilding its boiler house which was recently destroyed by fire. E. L. Pierce, Vice Pres. H. N. Cole, c/o Owner, Engr. Noted July 23.

N. J., Pompton Lakes—The city will receive bids until Aug. 7, for the erection of a brick and concrete power plant near Pompton Lake Dam. The equipment includes 2 turbines, engines, electric switchboard, etc. Estimated cost, $42,000. Noted July 30.

W. Va., Dana—The Dana Coal Co. has purchased the plant of the Canadian Pacific Coal Co. and plans to electrify same and install a 150 kw. generator set, electric hoist, etc. H. A. Jepson, Supt.

West Virginia—The Monongahela Valley Traction Co., Fairmont, will negotiate $5,500,000 loan, $2,500,000 of which will be spent in improvements to include the completion of the power plant at Rivesville, a gas producer plant at Lynn, and an addition to the power plant at Hutchinson, etc.

W. Va., Pt. Pleasant—Members of the Marietta Manufacturing Co., Marietta, Ohio, are organizing a company to build a factory here for the manufacture of steel hulls and barges and plan to install overhead electric cranes in same.

W. Va., Vaughan—The Ganley Coal Co., which has acquired the plant of the Greendale Mining Co., plans to install a complete 150 kw. power unit, motors, etc. M. E. Moore, Vice Pres.

La., New Orleans—The I. Newman Manual Training School plans to install a low pressure steam heating system in the new 2-story school to be erected on Saratoga St. E. Weil, Whitney Bank Bldg., Arch.

Ohio, Cleveland—The Aluminum Castings Co., Harvard Ave. and East 42nd St., plans to install a heating and power system in connection with the proposed 1-story factory to be erected on Harvard Ave.

Ohio, Cleveland—The Chicago Pneumatic Tool Co., 343 South Dearborn St., Chicago, Ill., plans to install a heating and power system in connection with the proposed factory to be erected on Lakeside Ave.

Ohio, Cleveland—The Electric Products Co., 1032 Scofield Bldg., plans to install a heating and power system in connection with the proposed 1-story factory to be erected on Clarkstone Rd.

Ohio, Cleveland—J. P. Farrelly, 1010 Superior Ave., plans to install a heating and power system in connection with the proposed church to be erected on Buckeye Rd.

Ohio, Newark—The City plans to install a 500 kw. turbine in the municipal power plant. C. H. Wells, City Engr.

Ohio, Oxford—The Board of Trustees, Miami University, will receive bids until Aug. 22, for furnishing and delivering an engine and generator for the central heating and lighting plant of Miami University. W. G. Franz, Cincinnati, Consulting Engr.

Mich., Saginaw—The General Motors Corporation will soon receive bids for the erection of a power house in connection with various other buildings which it plans to construct. F. D. Chase, 122 South Michigan Ave., Chicago, Ill., Engr.

Ill., Chicago—Bauer & Black, 25th St. and Dearborn Ave., plan to install a central power station and enlarge the existing heating plant in connection with the proposed 7-story factory addition. Holabird & Rocks, 104 South Michigan Ave., Archs.

Ill, Chicago—The Board of Education, 5 South Dearborn St., plans to install a low pressure heating system in connection with the proposed 3-story school to be erected on 63rd and Greenwood Sts. A. F. Husrauder, 5 South Dearborn St., Arch.

Wis., Blackereek—The Eastern Wisconsin Electric Co., Sheboygan, plans to build an extension from here to Appleton. L. P. Fessender, Power Sta., Sheybogan, Engr.

Wis., Manitowoc—The city is receiving bids for a turbo generator unit, one 3 panel switchboard, 1,500 kw. and 300 hp. boiler. R. Haupt, Clk.

Wis., West Allis—The Universal Machinery Co., 784 30th St., Milwaukee, will receive bids for engines, generators, switchboards, etc., for its steam generating plant.

Iowa, Clinton—The Klein Paper Co., 19th Ave., plans to build a power plant in connection with the proposed paper mill.

Iowa, Elkhart—The city is receiving bids for the erection of a transmission line, substation and distributing system. E. A. Lankford, Boone, Engr.

Kan., Baxter Springs—The Prospecting and Developing Co. plans to install air compressors, etc., in connection with the proposed 200 ton mill concentrating plant to be erected near Hockerville. J. Stackerford, Miami, Okla., Mgr.

Mo., Granby—E. L. Plank, E. Smith, and E. Rayury plan to install air compressors, etc., in connection with their new concentration plant. E. L. Plank, Supt.

Mo., St. Louis—The Fulton Iron Works Co., 1259 Delaware Ave., will receive bids about Aug. 10, for the erection of a 1-story, 60 x 150 ft. addition to its power plant. The project includes the installation of a 470 hp. boiler. R. C. Geppert, 1250 Delaware Ave., Engr. Estimated cost, $6,000.

Mo., St. Louis—The Horn Trunk Co., 1122 Washington Ave., plans to install a steam heating plant in connection with the new 4-story factory, to be erected on 8th and Howard St. C. B. McCormack, Columbia Bldg., Engr.

Mo., St. Louis—The Inland Machine Co., 1500 North Bway., will use electrical power from Keokuk Dam in connection with the proposed 2-story factory to be erected on Brown and Slevin Ave. The company will build a power plant when the additional buildings have been erected.

Ark., Mena—J. Abbott, A. Rebholtz, and A. Stewart of Tulsa, Okla., plan to install an engine and boilers in connection with their new concentration plant here.

Okla., Baxter Springs—The Tulsa-Sapulpa-Miami Associated Mines Co., Tulsa, Okla., plans to install an engine, air compressor, etc., in connection with its new concentration plant to be erected near Hockerville.

Okla., Douthat—J. J. McLellan and R. Munson plan to install an engine and boiler, etc., in connection with their new concentration plant. R. Munson, Supt.

Okla., Miami—The Miami Royal Mining Co. plans to install air compressors, engines, boilers, etc., in connection with the proposed 300 ton mill concentration plant to be erected at Monarch.

Okla., Quapaw—The Allied Lead and Zinc Co. plans to install air compressors, etc., in its concentration plant.

Okla., Quapaw—McCurdy Bros. plan to install an engine, air compressors, etc., in connection with their new concentration plant to be erected near Hockerville.

CONTRACTS AWARDED

Mass., Sherborn—The Sherborn Reformatory for Women has awarded the contract for furnishing 3 horizontal tubular return boilers, to International Engineering Works, 1029 Board of Trade Bldg., Boston. Estimated cost, $70,000. Noted July 9.

Conn., Bridgeport—The St. Vincents Hospital, 2820 Main St., has awarded the contract for the erection of a 1-story, 50 x 90 ft., reinforced concrete, steel and brick power house, to Swartz Bros., Bridgeport. Estimated cost, $30,000.

Conn., Hartford—The P. A. Frasse Co., 45 Boulevard, has awarded the contract for the erection of a 1-story, 41 x 42 ft. reinforced concrete boiler house on Arbor St., to Ellison Constr. Co., 60 Prospect St. Estimated cost, $8,000.

Conn., New London—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., received low bids furnishing one 5 kw. motor generator, from Hobart Bros., Troy, Ohio, $387; C. J. Bogue Electric Co., 513 West 29th St., New York City, $500; Eck Dynamo and Motor Co., Main St., Belleville, N. J., $504; Electric Products Co., 1057 East 62nd St., Cleveland, Ohio, $508; Diehl Manufacturing Co., Trumbull St., Elizabeth, N. J., $520; General Electric Co., River Rd., Schenectady, N. Y., $633.

N. Y., Buffalo—The Barber Asphalt Paving Co., 178 Walden Ave., has awarded the contract for the erection of a 1-story, 48 x 198 ft. and 30 x 126 ft. concrete, steel and brick boiler shop at 75 Roetzer St., to C. Berricks & Sons, 1151 Main St. Estimated cost, $50,000.

N. Y., Kings Park—The State Hospital Comn., Capitol, Albany, received low bids installing a heating system with underground service connections, at employees home, from W. B. Armstrong Co., 6 Fulton St., Albany, $12,998; Murtaugh & Reddington, 26 Pleasant St., Rochester, $14,800.

N. Y., Middletown—The Middletown State Hospital received low bids installing a heating system with underground connections at Tuberculosis Hospital, from G. E. Gibson, 103 Park Ave., New York City, $9,680; Murtaugh & Reddington, 26 Pleasant St., Rochester, $12,200.

N. Y., Schenectady—The American Locomotive Co., North Jay St., has awarded the contract for the erection of a 1-story, 75 x 110 ft. boiler shop, to Du Bois Bennett, 413 McClellan St. Estimated cost, $50,000. Noted May 21.

N. Y., Schenectady—The Board of Contract and Supply has awarded the contracts for the heating and ventilating systems and electric work in connection with the proposed Edison School, to be erected on South Center St., to C. Frank, Albany St., to Souter Co., 503 State St., $32,098 and $5,138 respectively.

N. J. Camden—The Public Service Gas Co., 80 Parks Ave., Newark, has awarded the contract for the erection of a 2-story, 36 x 78 ft. generator building to be erected on 2nd and Cherry St., to Mockett Construction Co., 6th and Market St. Estimated cost, $23,000.

Ohio, Cleveland—The National Woolen Co., 3131 West 33rd St., has awarded the contract for the erection of a 1-story, 52 x 82 ft. boiler house, to H. G. Slatmyer & Son Construction Co., 203 Lakeside St., N. W. Estimated cost, $16,000. Noted July 11.

Ind., Muncie—The Warner Gear Co., Clerk and Penn Sts., has awarded the contract for the erection of a 60 x 140 ft. boiler house, to Austin Co., 16112 Euclid Ave., Cleveland, Ohio.

Mich., Saginaw—The Saginaw Malleable Iron Co., Center and Salt St., has awarded the contract for the enlargement of its foundry and power plant, to J. S. Kearns, Detroit.

THE COAL MARKET

Boston—Current quotations per gross ton f.o.b. mines are as follows:

ANTHRACITE

	Circular Current
Buckwheat	$3.40
Rice	2.90
Boiler	2.65
Barley	2.40

All-rail rate to Boston is $2.86.

BITUMINOUS

Bituminous, $8 to $8.75.

Pocahontas and New River, f.o.b. Boston, $8.35 to $8.90.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* are as follows:

	Circular	Individual
Pea	$5.20	$5.95
Buckwheat	5.15	5.90
Rice	4.65	5.10
Barley	4.15	4.30
Boiler	4.60	....
Broken	6.75	7.50
Egg	6.35	7.10
Stove	6.60	7.35
Chestnut	6.70	7.45

Quotations for domestic coals at the upper ports are 5c. higher on account of the difference in freight rates. Prices for buckwheat, rice, barley and boiler are not fixed by the Government.

BITUMINOUS

Current quotations, gross tons, based on Government prices at the mines, net ton; f.o.b. Tidewater, at the lower ports, are as follows:

	Mine Gross	F.O.B. N.Y. Gross
Central Pennsylvania (Mine run, Prepared or Slack)	$3.30	$5.45
Upper Potomac, Cumberland & Piedmont Fields:		
Run of Mine	3.08	5.23
Prepared	3.36	5.51
Slack	2.80	4.95

Quotations at the upper ports are 5c. higher on account of the difference in freight rates.

The foregoing prices ar exclusive of the 3 per cent. war freight tax on both anthracite and bituminous.

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The ratte to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Current	One Yr. Ago	Current	One Yr. Ago
Pea	$3.45	$3.10	$4.60	$4.00
Barley	2.40	1.90	3.30	2.15
Buckwheat	3.40	2.90	4.45	3.80
Rice	2.90	2.40	3.80	3.40
Boiler	2.70	2.20	3.70	3.30

Chicago—Steam coal prices f.o.b. mines:

	Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes	$2.55—2.70		$3.25—3.40
Mine-run	2.35—2.50		3.00—3.15
Screenings	2.05—2.20		2.75—2.90

St. Louis—Prices per net ton f.o.b. mines are as follows:

	Williamson and Franklin Counties	Mt. Olive & Staunton	Standard
6-in. lump	$2.55-2.70	$2.55-2.70	$2.40@2.70
2-in. lump	2.55-2.70	2.55-2.70	2.40@2.70
Steam egg	....	....	2.40@2.70
Mine-run	2.35-2.50	2.35-2.50	1.85@2.00
No. 1 nut	2.35-2.50	2.55-2.70	....
2-in. screen	2.05-2.20	2.05-2.20	....
No. 5 washed	2.05-2.20	2.05-2.20	1.25@1.50

Williamson-Franklin rate to St. Louis is $1.10, other rates, $0.95.

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Prepared Sizes	Slack or Screenings
Big Seam	$2.50	$2.80	$2.20
Cahaba, Black Creek, Brookwood, Blue Creek	3.20	3.45	2.80
Pratt, Jaeger, Jefferson Nickel Plate	2.70	3.00	2.40
Corona	2.75	3.10	2.40

The above are Government prices per net ton of 2000 lb. mines and include the 45c. per ton allowed by the wage agreement less 10c. reduction which was effective May 25, as a result of the agreement with the railroad administration for furnishing fuel coal.

PRICES—MATERIALS AND SUPPLIES

These are prices to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

POWER-PLANT SUPPLIES

HOSE—

	Fire	50-Ft. Lengths
Underwriters' 2½-in.		80c. per ft.
Common, 2½-in.		25%

	Air		
	First Grade	Second Grade	Third Grade
¾-in. per ft.	$0.65	$0.40	$0.30

Steam—Discounts from List

First grade..... 15% Second grade.....25% Third grade.....33⅓%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition..... 50% Best grade..... 30%
Standard..... 40%

Note—Above discounts apply on new list issued July 1.

LEATHER BELTING—Present discounts from list in the following cities are as follows:

	Medium Grade	Heavy Grade
New York	40%	35%
St. Louis	45%	40%
Chicago	30+10%	40+5%
Birmingham	35%	35%
Denver	35%	30%

RAWHIDE LACING—40%.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam	$0.99
Asbestos for high-pressure steam	1.76
Duck and rubber for piston packing	1.10
Flax, regular	.99
Flax, waterproofed	1.21
Compressed asbestos sheet	1.10
Wire insertion asbestos sheet	1.32
Rubber sheet	.66
Rubber sheet, wire insertion	.99
Rubber sheet, duck insertion	.55
Rubber sheet, cloth insertion	.25
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.21
Asbestos wick, ½- and 1-lb. balls	.75

PIPE AND BOILER COVERING—Below are discounts and part of standard lists:

PIPE COVERING

Pipe Size	Standard List Per Lin.Ft.
1-in.	$0.27
2-in.	.36
6-in.	.80
4-in.	.60
3-in.	.45
8-in.	1.10
10-in.	1.30

BLOCKS AND SHEETS

Thickness	Price per Sq.Ft.
½-in.	$0.27
1 -in.	.30
1½-in.	.45
2 -in.	.60
2½-in.	.75
3 -in.	.90
3½-in.	1.05

85% magnesia high pressure..... 5% off

For low-pressure heating and return lines { 4-ply..... 58% off; 3-ply..... 60% off; 2-ply..... 62% off

GREASES—Prices are as follows in the following cities in cents per pound for barrel lots:

	Cincinnati	Chicago	St. Louis	Birmingham	Denver
Cup	7	5¼	13	8½	12½
Fiber or sponge	8	6	13	8½	20
Transmission	7	6	13	9	20
Axle	4½	4	4.1	3¾	5½
Gear	4½	4½	7.0	8	9
Car journal..... 22 (gal.)		3½	4.3	5½	8½

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	10.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 13¼	13¼ x 20⅝
Cleveland	$52.00	$58.00
Chicago	48.00	50.00

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw per barrel	$1.86	$1.16	$2.00	$1.20	$1.97	$1.21
5-gal. cans	1.96	1.26	2.15	1.35	2.17	1.36

WHITE AND RED LEAD in 500-lb. lots sell as follows in cents per pound:

	Red				White	
	Current		1 Year Ago		Current Dry and In Oil	1 Yr. Ago Dry and In Oil
	Dry	In Oil	Dry	In Oil		
100-lb. keg	14.00	14.50	13.25	13.50	14.00	13.00
25- and 50-lb. kegs	14.25	14.75	13.50	13.75	14.25	13.25
12½-lb. keg	14.50	15.90	13.75	14.00	14.50	13.50
5-lb. cans	.....	.....	15.25	15.50	16.00	15.50
1-lb. cans	.....	.....	.....	.....	17.00	.....

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	30%	45-5	45%
Tinned	30%	45-5	45%

Button heads, ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York...$5.65 Cleveland...$5.15 Chicago....$5.67 Pittsburgh...*4.65

Coneheads, same sizes:

New York...$5.75 Cleveland...$5.25 Chicago....$5.77 Pittsburgh...$4.75

REFRACTORIES—Following prices are f. o. b. works, Pittsburgh:

Chrome brick	net ton	$175.00
Chrome cement	net ton	75.00
Clay brick, 1st quality fireclay	per 1000	50.00– 55.00
Clay brick, 2nd quality	per 1000	35.00– 40.00
Magnesite, raw	ton	30.00– 35.00
Magnesite, calcined	ton	32.00– 35.00
Magnesite, dead burned	net ton	32.00– 35.00
Magnesite brick, 9 x 4½ x 2½ in.	net ton	110.00–125.00
Silica brick	per 1000	50.00– 60.00

Standard size fire brick, 9 x 4½ x 2½ in. The second quality is $4 to $5 cheaper per 1000.

St. Louis—High grade, $55; St. Louis grade, $40.
Birmingham—Fire clay, $55-60; silica, $55-60.
Chicago—Second quality, $25 per ton.
Denver—Silica, $35 per 1000.

BABBITT METAL—Warehouse prices in cents per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	125.00	70.00	108.00	73.00	100.00	70.00
Commercial	70.00	40.00	23.00	22.00	24.00	25.00

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$16–19	$14.00
Cleveland	20.00	12.30
Chicago	19.00	12.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

POLES—Prices on Western red cedar poles:

	New York	Chicago	St. Louis	Denver
6 in. by 30 ft	$5.59	$4.94	$4.94	$4.32
7 in. by 30 ft	7.40	6.60	6.60	5.80
7 in. by 35 ft	10.70	9.60	9.60	8.55
8 in. by 35 ft	12.20	10.90	10.90	9.65
7 in. by 40 ft	12.35	11.00	11.00	9.75
8 in. by 40 ft	13.75	12.15	12.15	10.65
8 in. by 45 ft	18.20	16.20	16.20	14.30
8 in. by 50 ft	21.85	19.45	19.45	17.15

10c. higher freight rates on account of double loads.
For plain pine poles, delivered New York, the price is as follows:

10-in. butts, 5-in. tops, length 20-30 ft	$9.00
12-in. butts, 6-in. tops, length 30-40 ft	11.50
12-in. butts, 6-in. tops, length 41-50 ft	12.50
14-in. butts, 6-in. tops, length 51-60 ft	21.00
14-in. butts, 6-in. tops, length 61-71 ft	23.50

PIPE—The following discounts are for carload lots f. o. b. Pittsburgh, basing card in effect July 2, 1917, for iron, and May 1 for steel:

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
¼ to 3	49%	35½%	¾ to 1¼	33%	17%

LAP WELD

2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
7 to 12	42%	28½%	4½ to 6	28%	15%
13 and 14	32½%		7 to 8	20%	8%
15	30%				

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼ to 1¼	47%	34½%	¾ to 1½	33%	18%
2 to 3	48%	35½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	9 to 12	15%	3%
4½ to 6	42%	30½%	7 to 12	25%	12%
7 to 8	38%	24½%	2½ to 4	29%	17%
9 to 12	33%	19½%	4½ to 6	28%	16%

From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
¾ to 3 in. butt welded	33%	42%	37%
3½ to 6 in. lap welded	15%	38%	33%

	Galvanized		
	New York	Chicago	St. Louis
⅜ to 3 in. butt welded	16%	22%	22%
3½ to 6 in. lap welded	+3	18%	19%

Malleable fittings, Class B and C, from New York stock sell at +5 from list prices. Cast iron, standard sizes, 10 and 5%.

BOILER TUBES—The following are the prices for carload lots f.o.b. Pittsburgh, announced Nov. 13, as agreed upon by manufacturers and the Government:

Lap Welded Steel		Charcoal Iron	
3½ to 4½ in.	34	3½ to 4½ in.	12½
2½ to 3¼ in.	24	3 to 3½ in.	+ 5
2½ in.	17½	2½ to 2¾ in.	+ 7½
1¼ to 2 in.	13	2 to 2¼ in.	+22½
		1¾ to 1½ in.	+35

Standard Commercial Seamless—Cold drawn or hot rolled

	Per Net Ton		Per Net Ton
1 in.	$340	1¾ in.	$220
1¼ in.	280	2 to 2½ in.	190
1½ in.	270	2¾ to 3¾ in.	180
1¾ in.	220	4 in.	200
		4½ to 5 in.	220

These prices do not apply to special specifications for locomotive tubes nor to special specifications for tubes for the Navy Department, which will be subject to special negotiation.

ELECTRICAL SUPPLIES

ARMORED CABLE—

B.&S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$104.00	$138.00	$164.00	$222.00
No. 12 solid	135.00	170.00	211.00	290.00
No. 10 solid	185.00	235.00	255.00	325.00
No. 8 stranded	235.00	325.00	345.00	450.00
No. 6 stranded	370.00	472.00	625.00	.....

From the above lists discounts are:

	Net List
Less than coil lots	10%
Coils to 1,000 ft.	15%
1,000 ft. and over	

BATTERIES, DRY—Regular No. 6 size red seal, Columbia, or Ever Ready:

	Each, Net
Less than 12	$0.40
12 to 50	.35
50 to 125 (bbl.)	.31
125 (bbl.) or over	.28

CONDUITS, ELBOWS AND COUPLINGS—Following are warehouse net prices per 1000 ft. for conduit and per unit for elbows and couplings:

	Conduit		Elbows		Couplings	
In.	Enameled	Galvanized	Enameled	Galvanized	Enameled	Galvanized
½	$66.56	$71.66	$0.1602	$0.1716	$0.059	$0.0632
¾	87.75	94.65	.2168	.2258	.0843	.0903
1	129.71	139.91	.3119	.3341	.1096	.1174
1¼	175.49	189.29	.4019	.4289	.1518	.162
1½	209.83	226.33	.5358	.5718	.1875	.2001
2	282.31	304.51	.9823	1.05	.25	.2668
2½	446.36	481.46	1.61	1.71	.3572	.3812
3	583.70	629.60	4.28	4.57	.5358	.5718
3½	729.56	784.76	9.47	10.10	.7144	.7624
4	886.17	951.57	10.93	11.67	.893	.953

From New York Warehouse—Less 5% cash.

Standard lengths rigid, 10 ft. Standard lengths flexible, ½ in., 100 ft. Standard lengths flexible, ¾ to 2 in., 50 ft.

CONDUIT NON-METALLIC, LOOM—

Size I. D., In.	Feet per Coil	List, Ft.	
⅜	250	$0.05½	Coils...55% Off.. Less coils, 40% off
½	250	.06	
⅝	250	.09	
¾	200	.12	
⅞	200	.15	
1	150	.18	
1	100	.25	
1¼	100	.33	
1½	Odd lengths	.40	
2	Odd lengths	.55	

CUT-OUTS—Following are net prices each in standard-package quantities:

CUT-OUTS, PLUG

S. P. M. L.	$0.11	T. P. to D. P. S. B.	$0.24
D. P. M. L.	.18	T. P. to D. P. T. B.	.38
T. P. M. L.	.26	T. P. S. B.	.33
D. P. S. B.	.19	T. P. D. B.	.54
D. P. D. B.	.37		

CUT-OUTS, N. E. C. FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp
D. P. M. L.	$0.33	$0.84	$1.68
T. P. M. L.	.48	1.20	2.40
D. P. S. B.	.42	1.05	.....
T. P. S. B.	.81	1.80	.....
D. P. D. B.	.78	2.10	.....
T. P. D. B.	1.35	3.60	.....
T. P. to D. P. D. B.	.90	2.52	.....

FANS—Following are prices of fans in New York:

DIRECT CURRENT

6 in.—Universal D. C. and A. C. Diehl	$ 6.00
9 in.—110 volt D. C. S&T Diehl or Sprague	11.00
9 in.—110 volt D. C. Osc. Diehl or Sprague	13.75
12 in.—110 volt D. C. S&T Diehl or Sprague or Eck	14.50
12 in.—110 volt D. C. Osc. Diehl or Sprague or Eck	18.55
16 in.—110 volt D. C. S&T Diehl or Sprague or Eck	17.25
16 in.—110 volt D. C. Osc. Eck or Sprague	21.25

ALTERNATING CURRENT

9 in.—110 volt 60 cycle A. C. S&T Diehl or Sprague	$11.00
9 in.—110 volt 60 cycle A. C. Osc. Diehl or Sprague	14.00
12 in.—110 volt 60 cycle A. C. S&T Diehl or Sprague	14.75
12 in.—110 volt 60 cycle A. C. Osc. Diehl or Sprague	19.50
16 in.—110 volt 60 cycle A. C. S&T Diehl or Sprague	18.25
16 in.—110 volt 60 cycle A. C. Osc. Diehl or Sprague	22.50

For 220 volt Winding—$1.00 additional

These prices are for fans 6 or more, less than this quantity add 10%.

FLEXIBLE CORD—Price per 1000 ft. in coils of 250 ft.:

No. 18 cotton twisted	$20.00
No. 16 cotton twisted	24.50
No. 18 cotton parallel	21.00
No. 16 cotton parallel	28.00
No. 18 cotton reinforced heavy	28.50
No. 16 cotton reinforced heavy	38.00
No. 18 cotton reinforced light	24.00
No. 16 cotton reinforced light	32.00
No. 18 cotton Canvasite cord	25.00
No. 16 cotton Canvasite cord	32.00

FUSES, ENCLOSED—

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

Discount:	
Less 1-5th standard package	30%
1-5th to standard package	40%
Standard package	52%

FUSE PLUGS, MICA CAP—

0–30 ampere, standard package	$4.20 C
0–30 ampere, less than standard package	5.00 C

LAMPS—Below are present quotations in less than standard package quantities:

Straight-Side Bulbs				Pear-Shape Bulbs			
Mazda B— Watts	Plain	Frosted	No. in Package	Mazda C— Watts	Clear	Frosted	No. in Package
10	$0.30	$0.33	100	75	$0.70	$0.75	50
15	.30	.33	100	100	1.10	1.15	24
25	.30	.33	100	150	1.65	1.70	24
40	.30	.33	100	200	2.20	2.27	24
50	.30	.33	100	300	3.25	3.35	24
60	.35	.39	100	400	4.30	4.45	12
100	.70	.77	24	500	4.70	4.85	12
				750	6.50	6.75	8
				1000	7.50	7.75	8

Standard quantities are subject to discount of 10% from list. Annual contracts ranging from $150 to $300,000 net allow a discount of 17 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Hubbell, porcelain No. 5406, standard package 250	$0.27
Hubbell composition No. 5467, standard package 50	.28
Benjamin swivel No. 903, standard package 250	.15
Hubbell current taps No. 5638, standard package 50	.35

RUBBER-COVERED COPPER WIRE—Per 1000 ft. in New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Duplex
14	$11.00	$12.50	$15.00	$24.25
12	14.23	16.92	19.48	32.25
10	16.92	22.83	25.81	45.00
8	27.65	31.40	35.50	61.00
6	.....	.....	56.00	.....
4	.....	.....	76.40	.....
2	.....	.....	112.45	.....
1	.....	.....	152.26	.....
0	.....	.....	182.90	.....
00	.....	.....	223.60	.....
000	.....	.....	271.24	.....
0000	.....	.....	332.40	.....

SOCKETS, BRASS SHELL—

½ In. or Pendant Cap.			¾ In. Cap		
Key, Each	Keyless, Each	Pull, Each	Key, Each	Keyless, Each	Pull, Each
$0.33	$0.30	$0.60	$0.39	$0.36	$0.66

Less 1-5th standard package	10%
1-5th to standard package	8%
Standard package	25%

WIRE, ANNUNCIATOR AND DAMPPROOF OFFICE—

No. 18 B.&S. regular spools (approx. 8 lb.)	46c. lb.
No. 18 B.&S. regular 1-lb. coils	47c. lb.

WIRING SUPPLIES—

Friction tape, ¾ in., less 100 lb. 40c. lb., 100 lb. lots	38c. lb.
Rubber tape, ¾ in., less 100 lb., 48c. lb., 100 lb. lots	45c. lb.
Wire solder, less 100 lb. 50c. lb., 100 lb. lots	46c. lb.
Soldering paste, 2 oz. cans Nokorode	$1.20 doz.

SWITCHES, KNIFE—

TYPE "C" NOT FUSIBLE

Size, Amp.	Single Pole, Each	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$0.42	$0.68	$1.02	$1.36
60	.74	1.22	1.84	2.44
100	1.50	2.50	3.76	5.00
200	2.70	4.50	6.76	9.00

TYPE "C" FUSIBLE, TOP OR BOTTOM

30	.70	1.06	1.60	2.12
60	1.18	1.80	2.70	3.60
100	2.38	3.66	5.50	7.30
200	4.40	6.76	10.14	13.50

Discounts:	
Less than $10.00 list value	5%
$10 to $25 list value	16%
$25 to $50 list value	24%
$50 to $200 list value	28%
$200 list value or over	31%